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MUNICIPAL NEWS

Issued Monthly at Hammond, Ind.
by Gillette Publishing Company, formerly
Engineering and Contracting Publishing Company

Executive and Editorial Offices:
221 East 20th St., Chicago, Ill.
Address all communications to the above office.

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Vol. LXXIV JANUARY, 1928 No. 1

The Superiority of Ford's Education

A few years ago Henry Ford sued a newspaper for libel because it had called him an "ignoramus" and other belittling names. In the trial the attorneys for the newspaper asked Ford many questions relating to American history, which Ford could not answer; and in his defense Ford made the widely quoted reply that "History is bunk." Whereupon newspaper editors from Portland to Portland had their laughs at Ford. And who doesn't like to smile at the assumed inferiority of any great man? It so tickles one's vanity to feel greater than the great.

Yet one of the greatest philosophers that ever lived, Herbert Spencer, had said almost the same thing—"history is bunk"—and he had said it in an essay on education that is even yet read (but not remembered) by most pedagogs. Spencer said that the mere learning of facts is of no importance unless they are facts that are to be put to use. A fact it is that my neighbor's cat had kittens yesterday, and just about as usable a fact as the chronology of England's kings, said Spencer. "Men dress their children's minds as they do their bodies, in the prevailing fashion, he added, and it is fashionable to know history and belles lettres. Then he contrasted the usableness of historical facts with scientific facts. The one class of facts are the ornaments of knowledge, the other class are the tools of knowledge. Which do you choose, he asks, to be gabby in history or successful in earning a livelihood and in preserving your health and that of your family?

Ford may never have read Spencer, but he certainly has followed Spencer's injunction, for his life has been one of scientific investigation and the application of the knowledge thus acquired. Read his biography if you doubt it.

Had Ford been able to cross-examine his cross-examiners in that celebrated libel suit, all he need have done to disclose their poverty of knowledge would have been to hand them one of Edison's questionnaires. You remember their character? A long list of scientific and semi-scientific queries that not one lawyer in a thousand could answer sufficiently well to get into a scientific kindergarten. Now who was the real ignoramus? Ford or the lawyer cross-examining him? The one, unknown to the world, the other known wherever modern machinery exists. The one, making a living by appeals to juries, the other making the greatest fortune ever accumulated, and in doing so, employing armies of men at the highest wages ever paid for similar work?

But some will reply, education is a school training whose object is to give breadth of culture. Would you give up such an aim for mere utilitarianism? Yes, we would. Breadth of culture? Who ever got it in any school, save the school in which each man is his own teacher? Breadth of knowledge must be a part of breadth of culture. Yet what breadth of knowledge does any school give you? Look over the score of books that you mastered in high school, and the two score that you mastered in college. Then go into any large library and walk for hours through the serried ranks of volumes—a million or more—asking yourself every few steps, what do my 60 school books contain compared with this million? Was the knowledge gained from the 60 broad? As broad as a drop of rain is to the globe toward which it falls.

So, breadth of knowledge can not be derived by study of the few text books of school and college. Can breadth of experience be thus acquired? Obviously not. What then is acquired by formal education under teachers that can be said to be truly broad? A breadth that is so far reaching that it enables a man greatly to surpass those who have it not? Just one thing: The training that makes a man a systematic searcher for usable facts and gives him skill in using the facts. Edison who had but meager schooling, attained such a breadth. Lincoln, with even less schooling, got it. Ford has it. Every great succeeder has had it.

We hear it argued that such great men need no teachers. Their genius makes them great. We don't believe it. Their teachers have been, first, the writers whom they have studied, and, second, Nature, whom they have interrogated. Nature includes, of course, all animate and inanimate things, and she speaks with a million tongues, if we but pause to interrogate her. Most of us never learn to ask her questions. A few do, and they become the discoverers. But at least we should be interested enough to ask those discoverers what they have discovered, yet few of us do.

So we conclude that the appalling ignorance of school trained men in general is evidence that their schooling failed to give them "breadth." Yet because they can still tell who Benedict Arnold was—well, that, sort of thing, in their opinion, makes them broad.

H. P. Gillette

Opening of Concrete Pavements to Traffic

The Beam Test as a Guide to Determine When Pavement Is Ready

By EDWARD E. BAUER
Instructor in Civil Engineering, University of Illinois

The transverse bending or beam test is being used more and more to determine the strength of concrete used in concrete pavements. Frequently sample beams are cast while the slab is being poured. The beams are then cured in the same manner as the slab and tested at various ages to determine when the pavement is ready to open to traffic.

What strength should the concrete have before it is ready to be used? This depends upon several factors: (1) the thickness of the slab, (2) the maximum load that is to come on the slab, and (3) whether provision has been made to transfer part of the load across the transverse joints and cracks.

Table I has been prepared based on Older's theory of pavement slab design. This theory may be stated briefly as follows: The pavement slab should be designed for its weakest portion, which occurs at the intersection of a transverse joint or crack and the edge of the slab or a longitudinal crack or joint. Tests indicate that frequently these corners are off the subgrade so that the slab acts as a cantilever beam. This cantilever beam then can easily be analyzed. The stress at the extreme fibre (the transverse bending stress) is given by the formula

$$S = \frac{3P}{t^2} \quad \ldots\ldots (1)$$

in which:

P equals the load in pounds applied at the corner.

t equals the thickness of the slab in inches.

If steel is included so that half of any load is transferred across any joint or crack, the formula becomes

$$S = \frac{3P}{2t^2} \quad \ldots\ldots (2)$$

In the table values of transverse bending stress are given for thicknesses of slab varying from 5 to 12 in. and for wheel loads of 6,000, 8,000, 10,000 and 12,000 lb., for both free and dowelled corners. No allowance has been made for impact. The stress varies directly as the load and inversely as the square of the thickness. For a given design the stress will increase or decrease as the loads increase or decrease, the stress for a 12,000 lb. wheel load being just twice that of a 6,000 lb. wheel load. For given wheel loads the stresses vary as the square of the thickness, the stress for a 12 in. slab being only one-fourth that of a 6 in. slab. Transferring half the load across a joint or crack is just like cutting the load in two.

Values in excess of 900 lb. are rare at 28 days and should not be counted upon unless test results show values that high. 600 to 700 lb. are average results for the usual 1:2:3 or 1:2:3½ mixes at 28 days. A number of factors affect the rate at which concrete gains strength, such as temperature, richness of mix, quality of cement, and curing methods. Testing is after all the only safe method to determine when a concrete pavement is ready to open and then the design and possible wheel loads must be taken into consideration.

Table I—Values of Transverse Bending Stress (extreme fibre stress) for Various Values of Thickness of Pavement Slab and Load for Both Free and Dowelled Corners

(Computations based on Older's formula)

Thickness of slab inches	Free Corner: None of load transferred across transverse cracks or joints. Wheel loads in pounds			
	6,000	8,000	10,000	12,000
5	720	960	1,200	1,440
6	500	665	835	1,000
7	370	490	610	735
8	280	375	470	565
9	220	295	370	445
10	180	240	300	360
12	125	165	210	250

Thickness of slab inches	Dowelled Corner: Half of load transferred across transverse cracks or joints. Wheel loads in pounds			
	6,000	8,000	10,000	12,000
5	360	480	600	720
6	250	335	420	500
7	185	245	305	370
8	140	190	235	285
9	110	150	185	225
10	90	120	150	180
12	65	85	105	125

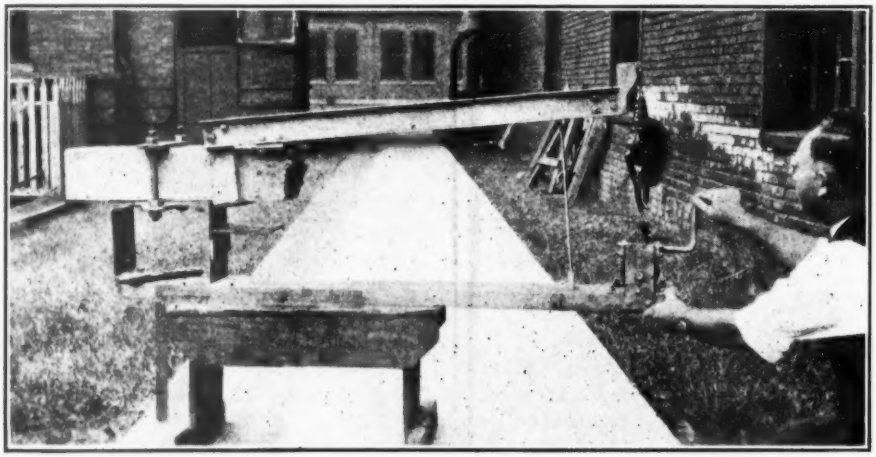


Fig.1.—Apparatus Used at the University of Illinois for Making Beam Test

Comparative Tests on Concrete Cylinders of Different Sizes

From November Technical News Bulletin of U. S. Bureau of Standards.

A series of 216 concrete cylinders, mixed and made in the field, half of which were 8 by 16 in. and the remainder 10 by 20 in., were recently tested at the bureau. The object of the series was the determination of the comparative strengths developed by the two sizes of specimens, using local sand and gravel under field laboratory conditions.

The cylinders were made in a small field laboratory, the concrete being mixed in a small batch mixer. Each batch was large enough to make four 8 by 16 and four 10 by 20 in. cylinders. After mixing to the desired consistency, the batch was emptied into a wheelbarrow and a shovel-full was placed into each of the paper cylinder molds in succession until filled. Each cylinder was properly tamped during filling.

Three mixes were used, 1:1:2, 1:1½:3, and 1:2:4. The 1:1½:3 and 1:2:4 were tested at 3, 7, and 28 days. The 1:1:2 mix was tested at 3 and 28 days. For each proportion the concrete was mixed to three consistencies giving the approximate slumps of 2, 4½, and 6½. Since the cylinders in each group have the same amount of cement, water, aggregate, and mixing time the strength ratio of the 10 by 20 and 8 by 16 should be unaffected by many of the variables which enter cylinder making when duplications of mixes are attempted.

The average strength of the 10 by 20 in. cylinders was 96 per cent of the average strength of the 8 by 16 in. cylinders. The strength ratios were 92, 98, and 96 per cent, respectively, for the 1:1:2, 1:1½:3, and 1:2:4, respectively.

In connection with the testing of cylinders of several sizes, it is important to note that if tested in one machine at the same platten speed the increase in strain will be slower for the small specimens, a phenomenon observed and noted in the test of mine stoppings[1] and by Prof. D. A. Abrams.[2] The strength ratios were opposite to what might be expected because of this effect.

[1]Technical News Bulletin No. 118.
[2]Eng. and Cem. World, Jan. 15, 1918.

Penetration Macadam in Illinois Towns

How Contractor is Paving Small Community Streets at Low Cost With Assurance of Long Service—Men and Equipment Required—Typical Specifications

In Elmhurst, Illinois, the citizens favor asphalt penetration paving for residential streets, and for the past four years the Rockford Road Construction Company has constructed a large percentage of this paving. The company specializes in bituminous construction and surface treatment work, and operates a fleet of ten bituminous distributors over the Northern Illinois territory.

At the time this article was written the contractor was paving DuPage and Berteau Avenues South from Lake Street to North Avenue. The total yardage was approximately 5,500 sq. yd. Only a small job, but it was done late in the Fall and quick work was necessary in order to take full advantage of the few days of good weather remaining. The concrete curb and gutter were constructed first and the grading followed. On account of the small amount of excavation, and the short haul, the grading was done with teams and Freznos hauling direct from the street roadway across the curb and sidewalk into parkways and low vacant lots which property owners desired filled. About ten "three-ups" were used for this work.

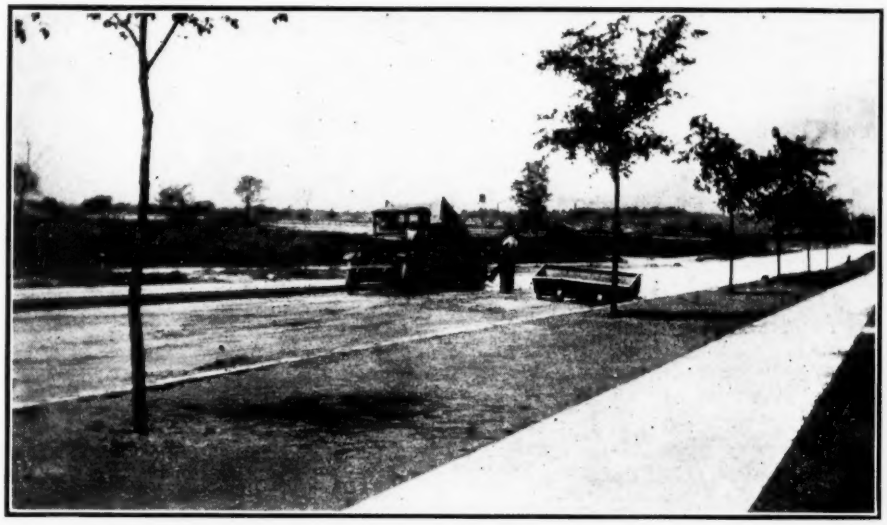


Fig. 1—Dumping Base Course Stone and Spreading by Means of Mechanical Spreader on Back of Truck, Left; and on Right, a Spreader Waiting for the Next Truck

After rough grading, manholes were adjusted and new catchbasins constructed. The fine grading was then handled by four men and rolling of the sub-grade with a ten-ton three-wheel gasoline roller immediately followed.

Base Course.—Crushed limestone for the base course was hauled from the Elmhurst quarry, a distance of about two miles from the job, and spread over the sub-grade by mechanical stone spreaders attached to the back of the trucks. Some 12 trucks were used during this operation. No. 5 stone (3½ to 5 in.) was used on the first course, spread to a depth of 5 inches compacted. Four men worked along with these spreaders straightening up the stone as it was dumped on the sub-grade, and after brief preliminary rolling the trucks began to haul limestone screenings over the base course stone. The screenings were well distributed over the stone, so as to fill all voids, after which the stone was dry rolled and more screenings spread. Following this the water-binding commenced and continued until the base was well screened and waterbound, constituting a solid course of stone and screenings firmly bound together. A period of forty-eight hours was allowed to elapse to permit the bottom base course to dry out before a similar procedure was followed for the second layer of base course.

This was constructed of No. 4 (2½ to 3½ in.) stone which is about one inch smaller in size than the stone used in the construction of the bottom base course. This second course was spread to a compacted depth of 3 inches.

Double Fork for Spreading.—One feature in connection with the spreading of the stone was the type of fork used by the men leveling off the stone. They used a type of fork which was so curved that it was possible to hook two forks together and men work opposite each other pulling back and forth. This method was an improvement over the ordinary one in that each man secured the maximum action from his own rake on the pull stroke, and in addition helped his partner on the back stroke. This made it possible for two men working together to level stone much faster than is ordinarily the case, and better work resulted.

Penetration Surface.—Over these two layers of waterbound base course, having a total depth of 8 inches, a two and one quarter inch asphalt penetration wearing surface was constructed. This consisted of No. 3 stone spread to a loose depth of 2½ to 3 in., rolled once to key it together, over which was applied by motor driven air pressure distributors 1¾ gallons asphalt binder, 95 penetration per square yard. Over this was spread a uniform covering of ¾ in. stone chips, to fill the voids between the No. 3 stone. After rolling the loose chips not held in place were swept off. This operation is important, as the usual mistake is to spread an excess covering of keystone. Over the keystone was applied a seal coat of ½ gal. to the sq. yd., also of 95 penetration binder, this in turn being covered with washed pea gravel and again rolled.

The keystone and gravel were spread by hand by two men shoveling from one-ton Ford dump trucks. The contractor used two trucks side by side, traveling in reverse down the street, each crew covering half the roadway width. Light trucks are used to avoid cutting ruts in the freshly asphalt-bound stone.

Application of bituminous material was made by distributors of a special design built especially for the contractor and incorporating the latest improvements. A sprinkling can with a special spreader spout is used for applying the bituminous material, should the distributor miss a step of stone during this course of its work.

Double Seal Coat.—The final or "double-seal" coat consisted of a cut-back asphalt, applied uniformly one-third gallon to the square yard, and covered with a mixture of clear torpedo sand and pea gravel, followed bvy rolling.

The contractor has made it his policy never to build penetration macadam without applying the double seal coat. The light bituminous material of the double seal coat is used to cut-back the heavier binder on the surface and the fine aggregate of torpedo sand and small gravel fills all surface voids. This gives a tightly sealed smooth surface which is impossible to secure with the single seal coat.

In the application of the "double seal," however, expert knowledge is

Fig. 2—Putting Finishing Touches on Base Course Prior to Rolling

necessary to avoid an excess of bituminous material on the surface, with its attendant evils of soft spots and bleeding in warm weather.

Double Seal Coat.—The final or "double-seal" coat consisted of a cut-back asphalt, applied uniformly ⅓ gal. to the square yard, and covered with a mixture of clean torpedo sand and pea gravel, followed by rolling.

The Contractor has made it his policy never to build penetration macadam without applying the double seal coat. The light bituminous material of the double seal coat is used to cut-back the heavier binder on the surface and the fine aggregate of torpedo sand and small gravel fills all surface voids. This gives a tightly sealed smooth surface which is impossible to secure with the single seal coat.

In the application of the "double seal," however, expert knowledge is necessary to avoid an excess of bituminous material on the surface, with its attendant evils of soft spots and bleeding in warm weather.

Specifications Used.—The Elmhurst work, done under the supervision of the Ed. Hancock Eng. Co., of Chicago, was governed by the following specifications that are used as standard by that engineering firm:

Bituminous Macadam Pavement

Grading.—The roadways of the specified streets including street and alley returns shall be so graded, that after being thoroughly rolled and compacted with a roller of not less than ten tons in weight, the surface of said roadway subgrade shall be ten inches below the surface of the finished pavement, and the parkways graded to the lines as given by the Engineer, which in general shall be a uniform slope from the walk to the curb.

Extra Concrete Over Trenches.—Where an excavation has been made in the subgrade during the past year, the Contractor shall dig out for a width of three feet wider than said excavation, the full length of said excavation in the subgrade, and to a depth of six inches. This digging shall be done after the subgrade is rolled, the bottom of said excavation thoroughly tamped, and then said excavation filled with concrete composed of one part Portland cement, three parts torpedo sand or limestone screenings and six parts broken limestone or gravel, thoroughly mixed and tamped into place. This same extra concrete shall be placed over the trenches made in the subgrade of the roadways for this improvement for any underground work herein without extra cost to the city.

Filling.—Where filling is required in the preparation of the subgrade for new pavement, it shall be made of good firm soil free from loam or vegetable matter or stone in excess of five inches in any dimension, and deposited in layers not more than six inches in thickness and thoroughly wetted and compacted by rolling with a roller of not less than ten tons in weight, and for resurfacing the filling shall be made with broken limestone bonded with limestone screenings and thoroughly wetted and rolled with a ten ton roller.

Disposal of Surplus.—In the grading of the roadways and parkways all surplus earth not needed for the filling of low places and bringing them to grade, shall be disposed of by the Contractor.

If any clean macadam is obtained in said grading, the city shall have the right to state where it shall be placed; but the Contractor shall not be put to any extra expense in said grading so as to keep the macadam separate from the dirt, or to haul it in excess of one-half mile without extra compensation.

Resurfacing.—(Not in this contract) The roadways of the streets, between the gutter flags, shall be scarified and shaped, and have added to the existing foundation, sufficient broken limestone, of a size to pass a ring two (2) inches in diameter and retained on a ring one (1) inch in diameter, together with limestone screenings to fill the voids therein, to bring the surface of the foundation two (2) inches below the surface of the completed pavement, after being thoroughly flooded with water and rolled and compacted with a roller of ten (10) tons weight.

Upon this foundation, as constructed and after it is thoroughly dry, a wearing surface two (2) inches in thickness, after being thoroughly rolled and compacted, shall be laid.

Said wearing surface shall be composed of broken limestone, broken so as to measure not more than two (2) inches nor less than one (1) inch in any dimension. After the spreading of this stone, the roller shall be passed over it to thoroughly key the stones together and bring the surface to the established grade of the street. No water shall be used in this course, and when the stone is thoroughly dry the bituminous binder shall be applied under pressure, by means of a mechanical spreader, or some other method which will insure an even distribution of the bituminous binder and a complete coating of the exposed surface of all stones. One and three-quarters (1¾) gallons of bituminous binder per square yard of pavement shall be

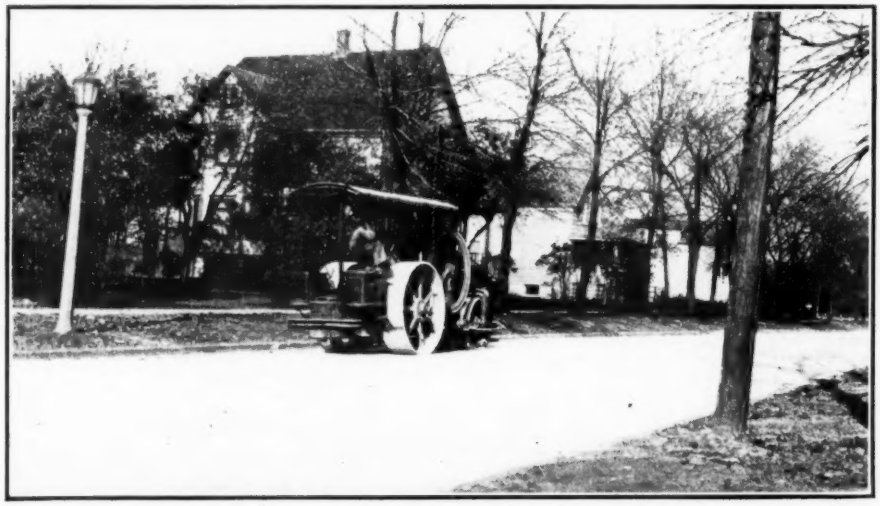


Fig. 3—Rolling the Base Course on Elmhurst Work

spread at this application. The temperature of the binder at the time of the application must be between two hundred fifty (250) and three hundred fifty (350) degrees Fahrenheit.

Immediately after the application of the bituminous binder, limestone chips, dry and free from dust, and all of which shall pass a one-half (½) inch screen, shall be evenly spread over the surface, so as to completely fill all the voids, and the surface rolled with a roller of not less than ten (10) tons weight, until the surface is smooth and true to grade and shows no signs of further compressibility.

Any excess chips shall then be removed from the surface of the roadways, and the second pouring of the bituminous binder applied, which shall be applied in the same manner, at the same temperature as the first pouring of binder, and to the extent of one-half (½) gallon per square yard of pavement.

Immediately upon this application of the bituminous binder, a layer of limestone chips, dry and free from dust, shall be applied to a depth of one-quarter (¼) inch and the pavement thoroughly rerolled with a roller of not less than ten tons weight.

The grade of the center of the completed pavement of the streets shall be two (2) inches above the average elevation of the opposite curbs, and a cross section of the top surface of said finished pavement shall be a true arc of a circle passing through a point one-half (½) inch above the upper and roadway corner of the gutter flag and the grade of the center of said finished pavement.

Pavement.—(New Work). Upon the roadways thus prepared and graded, between said points and between said gutter flags, shall be spread a layer of crushed limestone, broken so as to measure not more than five (5) inches nor less than two (2) inches in any dimension. This layer shall be five (5) inches in thickness, after being thoroughly compacted, and shall be passed over once with the roller to key the stones together, and then covered with sufficient limestone screenings so as to completely fill all interstices, then passed over with the roller, so as to get the screenings to the bottom of the interstices, and then flooded with water and rolled with a roller, weighing not less than ten (10) tons, until thoroughly compacted.

Fig. 5—Distributor Applying 1½ Gal. of Tar Binder per Sq. Yd. Followed Immediately by Covering of ¾ in. Keystone

On this layer, after being compacted, shall be spread a layer of broken limestone, broken so as to measure not more than two (2) inches nor less than one (1) inch in any dimension. This layer shall be of such thickness, after being thoroughly rolled and compacted, so as to be two and one-quarter (2¼) inches below the surface of the finished pavement. After spreading the stone on this layer, the roller shall be passed over it to key the stones together, and then covered with sufficient limestone screenings so as to completely fill all interstices, then passed over once with the roller, so as to get the screenings to the bottom of the interstices, and then flooded with water and rolled with a roller, weighing not less than ten (10) tons, until thoroughly compacted.

Upon this foundation, as constructed of these two layers of stone, and after it is thoroughly dry, a wearing surface of two (2) inches in thickness, after being thoroughly rolled and compacted, shall be laid.

Said wearing surface shall be composed of broken limestone, broken so as to measure not more than two (2) inches nor less than one (1) inch in any dimension. After the spreading of this stone, the roller shall be passed over it to thoroughly key the stones together and bring the surface to the established grade of the street. No water shall be used on this course, and when the stone is thoroughly dry the bituminous binder shall be applied under pressure, by means of a mechanical spreader, or some other method which will insure an even distribution of the bituminous binder and a complete coating of the exposed surface of all stones. One and three-fourths (1¾) gallons of bituminous binder per square yard of pavement shall be spread at this application. The temperature of the binder at the time of application must be between two hundred fifty (250) and three hundred fifty (350) degrees Fahrenheit.

Immediately after the application of the bituminous binder, limestone chips, dry and free from dust, and all of which shall pass a one-half (½) inch screen, shall be evenly spread over the surface, so as to completely fill all the voids, and the surface rolled with a roller, of not less than ten (10) tons weight, until the surface is smooth and true to grade and shows no signs of further compressibility.

Any excess chips or screenings shall be then removed from the surface of the roadways, and the second pouring of the bituminous binder applied, which shall be applied in the same manner, at the same temperature as the first pouring of binder, and to the extent of one-half (½) gallon per square yard of pavement.

Immediately after this application of

Fig. 4—Waterbound Base Ready for Spreading of Wearing Course Stone

Fig. 6—Applying the First Seal Coat

the bituminous binder, a layer of granite chips or birds-eye gravel, dry and free from dust, shall be applied to a depth of one-quarter (¼) inch, and the pavement thoroughly rerolled with a roller of not less than ten (10) tons in weight.

The grade of the center of the completed pavements of the streets shall be two (2) inches above the average elevation of the opposite curbs, and the grade of the center of the completed pavement of the alley intersections shall be two (2) inches below the top of the curbs. A cross section of the top surface of said finished pavement shall be a true arc of a circle passing through a point one-half (½) inch above the upper and roadway corner of the gutter flags and the grade of the center of said finished pavement.

Bituminous Binder.—The bituminous binder, if a tar binder, shall be free from water and organic materials. It shall have a specific gravity between 1.19 and 1.29 at sixty (60) degrees Fahrenheit, and shall be equal and similar to the product of the Barrett Manufacturing Company known as "Tarvia X." The bituminous binder, if an asphaltic binder, shall comply with the following specifications:

It shall have a specific gravity, at 77 degrees F., of not less than one (1.0).

The bitumen of the asphaltic cement shall be soluble in carbon tetrachloride, to the extent of at least ninety-eight and one-half per cent (98½%).

The fixed carbon of the asphaltic cement shall be not less than fourteen per cent (14%).

The melting or softening point of the asphaltic cement shall be not less than one hundred twenty (120) degrees F., nor more than one hundred thirty-five (135) degrees F.

The asphaltic cement, at 77 degrees F., with one hundred (100) grams for five seconds, shall have a penetration of from ninety (90) to one hundred (100), which shall be varied within these limits to adapt it to the particular asphalt used and to conditions of the street. When fifty (50) grams of the asphaltic cement, of the consistency used in the paving mixture, are heated for five (5) hours at a temperature of three hundred twenty-five (325) degrees F., in a tin box two and three-sixteenths ($2\frac{3}{16}$) inches in diameter by one and three eighths ($1\frac{3}{8}$) inches deep, there shall not be volatilized more than one per cent (1%) of the bitumen, nor shall the penetration, after such heating, be less than one-half (½) the original penetration.

Said asphaltic binder shall be similar and equal to the product of the Texas Company known as "Texaco No. 96."

The bituminous binder shall be applied from motor tank trucks, equipped with pressure spraying apparatus. Said pressure for applying the binder shall be between fifteen and thirty pounds per square inch so as to insure a thorough coating with bituminous binder of all the stone in the wearing surface. No binder shall be applied when the temperature is below 45 degrees F. and the surface of the stone shall be bone dry.

The Contractor shall make a third application of bituminous binder. This application shall be made to the extent of one-third gallon per square yard, thoroughly covered with granite chips or birds-eye gravel, to the extent of .01 cubic yards to one square yard of pavement and rolled with a ten ton roller. Said binder shall not be applied until the Engineer orders it, which will be after the traffic has produced the proper condition in the surface of the pavement and will be from three to six months after opening the pavement to traffic. The fifteen per cent reserve will not be held up however until this application of binder. The surface of the pavement shall be swept clear of all dust, dirt or screenings, and all loose or caked material removed before applying the bituminous binder and the surface shall be bone dry when the binder is applied.

Said bituminous binder shall be a tar or asphalt binder according as to whether tar or asphalt was used in the construction of the pavement and be approved by the Engineer.

Torpedo Sand or Limestone Screenings.—The torpedo sand, crushed granite or birds-eye gravel used in this improvement shall be clean, sharp, graded from fine to coarse, and passing, when dry, a screen having one-quarter (¼) inch diameter holes; shall be preferably of silicious material, clean, coarse, free from dust, soft particles, loam, vegetable or other deleterious matter, and not more than three (3) per cent shall pass a sieve having one hundred (100) meshes per linear inch.

Limestone.—The broken limestone used in this improvement for the pavement, shall be graded in size, retained on a screen having one (1) inch diameter holes, and passing a screen having two (2) inch diameter holes; shall be clean, hard and durable, free from dust, vegetable or other deleteri-

Fig. 7—Spreading Gravel Covering Over First Seal Coat

ous matter, and shall contain no soft, flat or elongated particles.

Resurfacing Work.—Wheaton, Illinois, was then visited. Here the same company had several contracts for resurfacing old macadam streets in the south side of town. Naperville street south from the DuPage County Court House to Roosevelt Road, was one of the streets being scarified, reshaped and rerolled, and resurfaced with tar penetration. Part of it was the regular penetration with heavy tar binder and the remainder modified penetration with medium Tar. The methods used in this construction were interesting.

The old pavements were originally waterbound macadam, surface treated with tar and asphalt. Ditches for construction of underground improvements, service cuts, holes and depressions in the pavement made necessary a complete resurfacing and because of the successful results obtained in similar work in other cities by this contractor, the City of Wheaton awarded them contract for resurfacing with tar penetration.

Scarifying.—For scarifying the old pavement the Contractor used a 12-ton Austin gas roller equipped with pneumatic 7-tooth scarifier. On account of the very solid surface of the pavement, it was necessary to start the scarifying with two scarifier teeth only, using more teeth as the surface became broken up. The pavement was scarified to a depth of 3 to 4 inches and then the loose stone was shaped to proper grade and crown with a blade grader. The surface was then rolled to ascertain where new stone would be necessary in order to secure a uniform texture in the surface, and also to fill in the low spots which developed during the rolling. For this medium macadam stone was used.

The surface was then given a prime coat of light tar which serves the purpose of penetrating into the road for a depth of ½ inch to 1 inch, as well as leaving enough tar on the surface for the subsequent layers of stone chips to adhere to. Following the prime coat of tar the roadway was lightly covered with ½ inch stone chips, and one day was allowed to elapse in order to permit the tar to dry out and set up. A second application of light tar was then made, and this also was covered with stone chips ¼ inch in size.

Fig. 9—Scarifying and Rolling Old Macadam in Wheaton. Teeth Behind Roller Give Combined Ripping and Rolling Action That Soon Breaks Up the Surface into Clean Stone

The surface was then given a thorough rolling and closely inspected to see that it had a uniform covering of stone chips and that all places in the road contained the same mixture of tar and stone. The final seal coat was then applied, consisting of a slightly heavier tar, and this application was covered with a mixture of washed pea gravel and clean torpedo sand, after which the roadway was given a final rolling.

This contracting firm has also performed similar work on Willow Avenue from Naperville Street West to Hale Street. This also was an old waterbound macadam road that had been cut up considerably for water and gas connections. The portion in front of the DuPage County Court House was widened from 30 to 36 feet and new curb and gutter constructed on both sides. In the remaining portions of the street wherever the curb and gutter were broken or cracked, they were taken out and replaced with new curbing. The sidewalks were also checked over at the same time, and wherever the old sidewalk had settled down or cracked, it was taken out and new sidewalk constructed at the proper grade.

Difficult Intersection.—In the course of the work on both Willow Avenue and Naperville Street, the Contractor had to be very careful with grades at the street intersections. A good many of the side streets were of concrete, somewhat flat and with hardly any crown, whereas both Willow and Naperville were old macadam streets with a high crown. This made it difficult to build the intersections low enough so that traffic North and South, and East and West could ride over the intersections without feeling any irregularities in the surface. At the intersection of Roosevelt Road and Naperville Street, an old monument had to be taken out in order to permit the widening of the intersection and building the approach to Naperville Street with a wider radius.

Fig. 8—Tar Penetration Pavement Six Months After Completion

Starting at Roosevelt Road, the property on the East side of Naperville Street for about 400 feet North of Roosevelt Road is approximately 5 feet higher than the property on the West side. The property holders had been complaining to the City that with the pavement four or five feet lower than their property grade, it was impossible for them to construct driveways connecting their grades to the street without having a steep incline. To correct this condition, the City decided to raise the level of the pavement along the West curb 12 to 15 inches, and this was accomplished by constructing the new curb and gutter directly on top of the old curb and gutter, and constructing the new penetration macadam pavement on top of the old street at the

West curb. The waterbound macadam then was spread over the old pavement to a depth varying from 3 to 12 inches, and at the East end of the street the old pavement was scarified so that the waterbound base could be tapered down to a depth of about 2 inches. After shaping and rolling this waterbound base to the proper grade and crown, a 2½ inch tar penetration top was then constructed over the entire width of the street.

The Wheaton work was done under the direction of George W. Stickney, City Engineer.

River Forest Work.—The writer learned that in two other cities nearby the same contractor has recently completed two similar projects. In the Village of River Forest, they scarified and resurfaced with a 2½ inch top the old waterbound macadam pavement on Iowa Street from Harlem Avenue

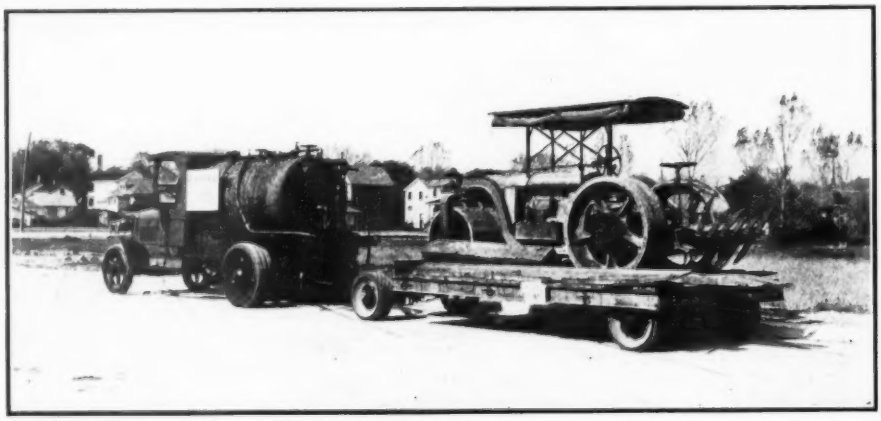


Fig. 10—A Distributor Towing Small Roller with Scarifier, on Trailer, to New Job. A Large Roller Is Moved Under Its Own Power

West to Lathrop Avenue including all the street intersections. The street had had about four months of traffic when the writer saw it at the time this article was written, and it had ironed out to a smooth texture resembling asphaltic concrete in appearance. In the City of Lake Forest the Rockford Road Construction Company, during July and August, widened and resurfaced Deerpath Avenue from Green Bay Road East to Bank Lane. On Deerpath Avenue the old pavement was waterbound macadam surface treated with tar or asphalt, about 24 feet wide. This street was widened to 44 feet at Bank Lane, narrowing gradually to a width of 30 feet at Green Bay Road. New curb and gutter, new sidewalks, new catchbasin inlets with new underground drainage were included in this improvement, and this street also had ironed out to a very smooth finish.

The company is now said to be experimenting with a new type of surface for their bituminous penetration construction, and they expect that with this new type of surfacing they will obtain a surface just as waterproof, smooth and durable as any other type of pavement, be it asphaltic concrete, sheet asphalt, or any similar type of blacktop pavement.

Salvaging Old Pavements.—Aside from their activity in the construction of new bituminous penetration pavements, this contractor is constantly salvaging old pavements. They have various methods which they recommend for salvaging old pavements, varying from a light surface treatment to a complete resurfacing with 3 inch bituminous wearing surface, using the old pavement as a base.

So successful were their early activities in this territory, the company originated the policy of guaranteeing their work for periods varying from one to five years, backing up their guarantee with a maintenance bond issued by one of the largest surety companies. Whether a job is guaranteed for two years or five years depends on the character of the paving work, conditions of road bed, drainage, etc. Four of the company officials are actively engaged in promotion sales and construction work, each man covering a certain territory in the district of Northern Illinois between the east and west boundaries of the state. They have also been active in Wisconsin.

In order to provide work for their organization 12 months of the year, this company is one of the few road contractors with a winter business. The company owns and operates the North Shore Petroleum Co. a subsidiary organized to sell and deliver fuel oil to homes, hotels or apartments and factories. A fleet of 5-ton GMC trucks is used for fuel oil delivery, the distributor tanks being removed and the regulation type of gasoline and oil tank mounted in its place.

Plant and garage are located at 5929-41 Rogers Avenue, on the extreme northwest side of Chicago, where the company also maintains its general office for both the paving and fuel oil divisions.

Study of the Factors Governing the Strength of Concrete

From November Technical News Bulletin of U. S. Bureau of Standards.

The bureau has completed a study of the variables entering into the fabrication of concrete, in which 3,000 cylinders were prepared and tested. Some tentative conclusions from these tests have already been reported in the November, 1926, Technical News Bulletin under the title "Water-cement ratio in concrete."

The variables studied are as follows:

1. Quality of cement. Four brands of Portland cement with different characteristics were used.

2. Gradation of the coarse aggregate. Eighteen gradings were studied.

3. Ratio of fine to coarse aggregate, four ratios being used.

4. Types of aggregates: Gravel, slag, and crushed limestone.

5. Age. The specimens were tested at six ages, namely, 1, 3, 7 and 28 days, and 3 and 12 months.

6. Proportions of mix. 1:1½:3, 1:2:4, 1:3:6 mixes were used in most part.

The specimens were removed from the molds at 24 hours and then placed in damp storage until test. All concrete was made of such consistency as to develop a flow of 95 as measured by the flow table, using 15 ⅛-in. drops The following conclusions may be drawn from the results of the tests:

1. At the ages of 1, 3, 7 and 28 days the variations in quality of the cement produced marked differences in the strengths of the 1:2:4 concrete. At the 3-month age, however, the difference in strengths was 9 per cent in term of the strength of the lowest one, and there was about 6 per cent at the age of 1 year.

2. The ratio of the strength of the concrete made from the four cements at 28 days varied from 1.96 to 2.76 of the strength at 7 days, under the conditions affecting this series of tests.

3. The proper ratio of fine to coarse aggregate for maximum strength depended on the type of the aggregate and its grading.

4. In most cases, when the coarse aggregate was deficient in one or two of the smaller sizes, that is, those varying between No. 4 to ⅜ in. and ⅜ to ¾ in., a markedly better workability, together with very little change in strength, was obtained when using a mix in which the fine aggregate was 50 per cent of the total aggregate than when the fine aggregate was less than 33⅓ per cent of the total aggregate.

How They Remove Snow From Streets and Sidewalks

A Number of Cities and Towns Report Snow Removal Methods and Equipment—Some Show Interesting Costs

There are a number of things that can try the temper of the taxpayers of any community, but possibly none so much in the northern or snow states as the condition of blockaded streets and sidewalks after every snow storm. Stalled cars, isolated stores and schools, paralyzed business—all take their toll of money and of temper. Then a thaw that turns the pavement into a morass of slush, which turns to dangerous ice on the next freeze. Not a pretty picture—but one that might be remembered at the next election.

It is but natural, therefore, that the modern city administration has usually given thought to removing the snow before it can create a really hazardous condition.

Snow removal is a necessity, unless we are in a position to follow the jocular advice of our friends in the south or in California to the effect that it is better to remove one's self from the snow than to remove one's snow from the streets. In this connection, refer to the page from California that was compiled and has been presented just for the sake of a little comparison and a little fun!

But to get down to the really serious purpose of this symposium—the discussion of the removal of snow from the streets of the community exposed to this necessary evil.

As may be seen from the following statements, there are many conflicting ideas on the subject. Most of the policies and methods expressed by these authorities are the result of long experience. Almost any one of them may present new ideas that are of real value. In our original inquiry that resulted in these interesting statements we sought to find the best solution for the problem, but has this one best solution been found? Perhaps our readers had best decide this for themselves. Perhaps there is not even one best solution. There may be many. Too many variables enter into the equation, such as frequency and depth of snow, mileage of streets and walks to be maintained, per capita wealth in the community, money immediately available, organization of the local government, the educational system of the city, the buying habits of the citizens, the availability of labor, the availability of snow removal equipment, and so on.

Permit us, then, to merely present the various views and experiences reported, and let the reader compare and judge the merits of each for himself.

As part of its service to its readers, Municipal News has asked the officials of a number of cities and smaller communities what methods and equipment they found to be the most effective in removing snow from their streets and sidewalks. The replies are interesting. They present information that should prove helpful to every community in the snow states, many of whom are now carrying on their annual struggle against this manifestation of nature that so effectively slows up the organic life of the community and that so seriously cuts in on the business of the merchants upon whose prosperity the community so depends. This is but one of many important civic problems that will be discussed from time to time in this journal.—The Editor.

John P. Dietrich, Deputy City Manager of the City of Cincinnati, Ohio, of which Col. C. O. Sherrill is City Manager, reports that "Cincinnati has very little snow and therefore no definite plans have been made for its removal. There are no detailed plans involving machinery and manpower. We find that it is cheaper to use straight manpower and trucks with a few snow plows attached to tractors than it is to purchase and keep on hand a finer snow removing equipment. However, where snow is plentiful during the winter, I am convinced that the equipment is by far the cheapest and best method for removing the snow."

John H. Edison, Superintendent Highways and Sewers, of the City of Grand Rapids, Mich., reports as follows:

"In January, 1923, we purchased one Wehr grader mounted on a Fordson tractor, which cost $1,400. This machine proved so efficient that we have added to it until we now have six of these graders.

"Tractor grading cost us $10.61 per mile. I must state the fact that these graders are our best piece of equipment. You will notice that tractor grading costs more per mile than the others. The reason for this is that they grade the downtown district where we have some 60-foot roads, while the others work on the outskirts of town where some of the pavements are as narrow as 16 ft. These graders also keep working in front of the snow loader and keep building up wind-rows; they also cut and shave the ice ruts out of the streets, and that is much slower work where you cannot use the others for this kind of work.

"In 1924 we purchased a Fox rotary snow broom at a cost of $5,500, which we mount on a 5-ton truck in the wintertime. The cost of sweeping the snow with this machine is $3.78 per mile. We use this broom on the outskirts of the city because it throws the snow so far that it would cover all the sidewalk, and this machine can only be used when the snow first falls. When the snow packs down this machine cannot clean it from our streets.

"We also purchased four Champion snow plows mounted on the front end of our trucks. These plows are only good for when the snow first falls. The cost of plowing with this equipment is $3.53 per mile.

"In the winter of 1925 and 1926 we purchased a Nelson snow loader at a cost of $3,150. We loaded and hauled the snow away at a cost of 24c per cu. yd., and the old method of shoveling cost 46c per yd. This machine cut the cost of loading and hauling snow 22c per cu. yd., so that we have purchased another loader for this year's work.

"In hauling this snow, we start to work at 12 o'clock at night so that we will not be bothered with so much traffic; it took four nights to clean the downtown district last winter. By adding this new loader, we can clean the downtown district in two nights, which has about 4 miles of streets, then we start and clean the business district toward the outskirts.

"With the equipment that we have, we can grade about 75 miles of streets, and we haul the snow away from about 10 miles of our streets.

"Sidewalk snow plowing is quite an interesting thing with us. Until last year we would have as high as 55 horses attached to snow plows, so we got a plow and attached it in front of a Fordson tractor that would jump over curbs. It only takes eleven of these plows to do this work and it does a much better and quicker job."

Courtland R. Darrow, Superintendent of Streets of the City of New London, Conn., reports that this city, with a population of 30,000, keeps 62 miles of streets open throughout the winter. For this work he now has 3 blade plows attached to a F W D truck, 1 blade plow attached to a Cletrac tractor, 1 Wehr grader attached to a Fordson tractor, and 1 horse drawn plow for park sidewalks. The blade plows start when the snow is 3 in. deep and

push the snow to the sides of the street. On main thoroughfares and in the central portion of the city, this snow is then loaded by hand into hired trucks and dumped into the harbor. For this purpose, a force of from 80 to 100 men is hired, from 10 to 12 trucks are called in, and the total cost is found to average approximately $12,000 a year. The average snowfall is about 24 in. The labor is secured from the Street and Water and Sewer departments, and this is increased from the local labor market as needed. No difficulty is experienced in securing this additional labor. His department is now considering the purchase of a snow loader, believing that this equipment will help reduce costs.

C. A. Eckbert, Borough Manager, Borough of Milton, Milton, Pa., reports that his community of 8,000 uses modern methods of snow removal. Half the cost is borne by the borough and half by the merchants. The equipment used consists of a one-man operated Austin International 10-20 h. p. unit Motor Grader with a 10 ft. blade, 15 in. high, and three 6-ton motor trucks. A force of 20 laborers is used. This outfit is reported to clean a 20-in. snow from curb to curb on a street 4,500 ft. long and 30 ft. wide in 30 hours, at a cost of $400. The snow is loaded into the trucks and dumped on the bank of a creek that is at a distance of 1,000 ft. from the street at one end and 1,700 ft. at the other end. The borough has a total of 20 miles of road to keep clear during the winter. During the winter of 1926, there were two heavy snows, and the cost of removal on these two occasions was reported to be $886.50.

C. M. Osborn, City Manager, of the City of Kenosha, Wisconsin, makes the following interesting report:

"The City of Kenosha keeps its streets open during the winter months by the use of snow plows when the fall of snow is heavy enough.

"On the ordinary street, the snow is moved to the gutter and allowed to remain there until the weather warms up and the snow thaws. In the downtown business section and also in several of the business centers in outlying sections, the snow is actually removed from the street and hauled away to dumps and vacant lots. In these locations the snow is first shoved to the gutter or in windrows and is loaded on trucks and other vehicles, either by hand or by machinery, and hauled away.

"The loading by hand is not as economical as loading by machinery, but it has been done here because it helps to put the human element into the city. We find that along during the heavy snow season there are a great many citizens out of employment, and possibly have been out of work for some little time, and a few days of snow shoveling helps to put them on their feet and keep them self-supporting. In a number of cases if the snow was loaded by machinery and these men were not employed, it would be a case of where the city would have to spend the savings made by using the machinery to support these men while they are idle.

"The City of Kenosha has an ordinance that provides that every property owner must see that the snow is removed from his sidewalk within twenty-four hours from the time it falls. This ordinance has been enforced for a number of years so the citizens respond very quickly after a snow fall and the sidewalks are usually cleaned within the limited time.

"Those citizens who do not clean their sidewalks receive a call from the police officer on the beat. He leaves a printed notice at the house which states that unless the sidewalk is cleaned within the proper limit of time the owner will be arrested and the sidewalk cleaned by the city at the expense of the property owner. This is more than a gentle reminder; it is a reminder that in at least ninety-nine cases out of a hundred gets action from the citizen.

"This method is applied in the well-developed residential sections of the city. In the outlying sections the city actually plows the snow from the sidewalks after every snowfall.

"Due to actual enforcement of the snow removal ordinance over a period of years, our citizens have become trained in the habit of removing the snow, and the results are very good."

A. S. Potts, City Manager, Cooperstown, N. Y., states that they "do very little real snow removal. Of course our sidewalks are scraped after each considerable snowfall by one-man one-horse scrapers. The frequency of these snowfalls varies, averaging 15 or 20 times each season. Each scraping requires 3 to 5 hours for three men and three plows.

"The snow shoveled from our wide walks into the gutters on Main street by our business men is drawn away in sleighs with large boxes. All of this work is done by two year hands and one or two extra men when needed. I cannot say as to the quantity removed per day or hour. The depth of the snow varies from 50 to 100 in. per season."

R. W. Arthur, City Manager, City of Radford, Va., reports his city small and the snow removal work done by their Adams Patrol Road Machine, attached to the rear of a truck. He claims that this method works very well, as he has very light snows, as a rule, and very few improved streets to cover. A total of two days a year are required for this work, and the labor cost totals 60c an hour, since one man is needed on the truck and one on the machine, at a wage scale of 30c per hour.

C. G. Gran, City Manager, Rhinelander, Wis., informs us, that, "The past year we had little trouble with snow removal. I used a 5-ton Holt and plow for bad drifts, but most of the work was done with my Hadfield-Penfield grader.

"The snow was shoved to the center of the street, then gathered in trucks and dumped into the river.

"By keeping my gutters clean I had very little trouble in the spring when the snow began to melt.

"My total cost from January 1, 1927, to date (October) has only been $414.40, which is about $1,500 cheaper than the cost of the previous year."

H. A. Yancey, City Manager, City of Charlottesville, Va., had the following to say on the subject:

"We do not attempt to move snow from our streets unless there has been a fall of 6 in. or more and since the climate of our particular section is more or less moderate, the matter of snow removal does not present a serious problem.

"Where there is no curb in the outlying districts on the paved streets we simply scrape the snow to the gutter with a one-man grader or road machine.

"On our main thoroughfares the snow is scraped in ridges to the gutter and removed by hand.

"The little of this work that we are required to do is charged to the Public Service Department against general operation and not segregated from other matters. I am, therefore, unable to present accurate figures on same."

Ralph McMillan, City Manager, of Sterling, Kans., reports that their snowfall is very light, and that in fact during the past two years they never had more than an 8-in. snow. They use a short drag to remove the snow from the sidewalks, using one man and one horse to the drag. Two drags are operated. For cleaning the streets, they use a grader in the gutter, keeping the gutters clear so that the water will move off as fast as the snow melts.

E. Eldred, City Manager, City of Otsego, Mich., writes that they use a one-horse snow plow for sidewalk cleaning, and a Fordson one-man grader to clean the business streets, which are wide. He suggests that a small, narrow tractor of the caterpillar type would prove useful for sidewalk cleaning, since horses are getting difficult to obtain. Here is a suggestion that he makes: "Why not pave streets with centers low intead of high, with no curb, and a sewer in the center with plenty of manholes. During the winter the snow could be scraped into the center and let into this storm sewer. This would do away with catch basins and laterals." (This would make a good topic for discussion.—Ed.)

Peter Walraven, City Manager, City of Iron River, Mich., reports that they use Ideal snow scrapers to clear the business districts and a 10-ton tractor and plow in the other parts of town. The business blocks are 300 ft. between intersection center lines and the business street is 70 ft. wide between property lines. The snow is hauled away from the business district. The longest haul is 2½ blocks. The cost of this snow removal varies with the snowfall, and the work is done when the snow

reaches a depth of 2 in. This cost, which varies with the snowfall, will run from $10 to $25 per block. The type of scraper used requires the services of one man and a two-up team.

J. P. Broome, City Manager, Summit, N. J., wrote as follows: "We use six plows to remove the snow from the middle of the street, two of these being of the "A" type and four are blades. We use a Nelson loader to load the snow from the business section of the town. We have just purchased this machine and have not as yet had a chance to test it out thoroughly. We had two snows last winter that averaged 6 in. each, but that is considerably less than usually falls."

C. O. Roskelley, Manager of the Brigham City Corporation, Brigham City, Utah, tells us that this city flushes all snow into the gutters with drainage to a creek, while street graders are used in case of heavy snows. He reports that this service has been satisfactory to date.

W. E. Hegenbothen, City Manager, Holyoke, Colo., a small community, reports that they are so situated as to have but little snow, and that the bulk of their snow removal consists of sending out men and teams to clean the walks and open up a lane through the center of the street. Sometimes they have used their Fordson grader to help in this work. What snow they have soon melts and drains away. The total cost per year probably does not exceed $100.

A. M. Wilson, City Manager, City of Colorado Springs, in the same state, reports that in their location in a high altitude and close to the mountains the snowfall is very light, seldom being greater than a few inches and never exceeded a foot. Snow blades have been provided for the municipal trucks and a larger type plow is mounted on a Caterpillar tractor. The sidewalks are very wide. After a storm the snow is shoveled into the gutters, from which it is loaded by hand and hauled to a creek or to a nearby vacant lot, or otherwise disposed of. During the winter of 1926-27 the total cost of snow removal in this community was $2,570.57.

C. H. R. Fuller, City Manager, City of Chatham, Ontario, Canada, has made the following report on their snow removal methods:

"The City of Chatham consists of approximately 30 miles of sidewalk and 30 miles of paved road. The city looks after the clearing of the sidewalks and also the keeping of gutter and catch basins, on each side of the road, free of snow for the purpose of drainage in the case of a thaw.

"The city is divided into nine districts, each district has an overseer, living preferably in that district, and each overseer is responsible to the general foreman. These men are liable to be called out at any time. In the case of a snow storm in the night, the men usually commence clearing at 4 a. m. Each overseer knows and is responsible for his own district.

"In the year 1926 it was necessary to clear the city seventeen times of a fall of snow, varying from 2 to 4 in. This is more or less typical of a year's work.

"For clearing sidewalks we use a V shape wooden plow with handles, and drawn by one horse. In the case of clearing the gutter out it is customary to use an ordinary road scraper.

"Local labor is entirely used, and it is customary to select men who are in more or less unfortunate circumstances.

"Each district contains 9 miles, which takes about 6 hours to complete, at a cost of 60c per hour, including the horse. The cost per district is approximately $5.50, or for clearing the city, approximately $50."

Fred W. Smith, City Manager, Flushing, Mich., sent us this letter that appears typical of the conditions and methods encountered in the small town on a main highway:

"Our snow removal is not a heavy expense and varies to such an extent that it would be a hard matter to make any definite cost for the same. We are out on a state highway running through Main street, and county or state machines go right through the town and push snow to the sides. We have a Ford ton truck with No. 2 dump body that is used for all hauling purposes. We also employ one man continually who supervises all municipal work, and in snow removal work he hires extra help. It takes from one to two days for each removal, as we are a small town and have only two blocks to keep snow from, and some years only one removal is required, and from that to three times. Each removal costs from $10 to $25, according to the amount of snowfall. Our snow is dumped in a vacant lot or in the river."

G. E. Wild, of Morton, Ill., gives the following information:

"This village maintains a day and night police force, who are instructed at all times to remove all snow as soon as it becomes troublesome.

"This village uses a snow plow which can be handled with one horse, and having all cement walks and about three miles of paved streets, we have no trouble having a passage way through the snow.

"Our costs in handling our snow proposition this way is small, practically nothing, but the horse hire."

Wallace Lawrence, Town Manager, Town of Salem, Va., reported that his community had but two snows last winter that required removal from the streets. They were approximately 4 to 6 in. in depth and were removed by the use of a small grader pulled by a motor truck.

Norman G. Young, Borough Manager, Hollidaysburg, Pa., writes that, "Our snow removal methods would not interest you, for the reason that the Blair County plows go over our secondary streets gratis, and on the main business streets the Altoona and Logan Valley Electric Railway Co. pays the costs of trucks, while we furnish the labor. Therefore, our costs are small. We are fortunate in that this is a county seat town and also the headquarters of the County Highway Department, and the State Highway District Department, all of which use their equipment on our streets gratis."

W. E. Baumgardner, City Manager, Bay City, Mich., reports that, "For some years past this city has not experienced much trouble in taking care of snow. Have had very few storms and not very severe, not to exceed 8 in. fall at any time. We take care of removal of snow from sidewalks with horse drawn snow plows, and on highways with graders and trucks."

A City Engineer, speaking for a good sized community in Ohio—for his own sake we will not mention his name—has written the folowing diatribe on the subject:

"Yes, winter is coming and so is snow, and the powers that be have not done a darned thing to remove the latter.

"When the snow comes, one might think it were as unexpected as a tornado. First the sewer gang gets out early and cleans out the gutters. The melted snow must find its way to the inlets. Then the sidewalk gang and the property owners clean the walks and shovel the snow back into the gutters. The street railway company has been working all night sweeping snow from the tracks to the roadway and the city pushes it right over to the poor old gutter again. There it rests until it has become a solid cake of ice and for about two months we spin our wheels, and skid and get towed, and when April finally comes, we think, Thank God that's over!

"You addressed me as City Manager. I am only a City Engineer under my mayor. If I or anyone else were City Manager, the answer to your letter would read differently."

C. H. Brown, City Manager, of Cass City, Mich., reports that his town ordinarily does not remove the snow from the streets, but sends a man over the sidewalks with a horse drawn plow, the job taking ordinarily from 10 to 12 hours, and showing an average cost of $50 a year. One time last winter the snow had to be removed from the parking space on Main street. This operation was effectively done by first leveling it down with a team and grader, and then packing it by drawing a heavy timber over the surface. This made the snow hard enough for automobile traffic.

R. M. Wilcomb, Municipal Manager and Treasurer, Springfield, Vt., wrote that they operate one 5-ton Holt and one Fordson full crawler with Sargeant plows. Hauling is mostly done by truck.

With this equipment they are able to handle such snowfalls as are usual in Vermont winters.

W. Murray Eaton, Chairman, Board of Selectmen, Wenham, Mass., tells us that his community is a small town with 18 miles of streets to keep open. They use a Fordson full crawler with Sargeant plow and a 5-ton Packard truck with a Good Roads plow. He is very favorably inclined toward the former unit as the most practical for the small town.

S. O. Hale, City Manager, Xenia, Ohio, reports that his community uses horses and sleds to clear paths when the snow is deep, but that fortunately their snows in recent years have been light and easily disposed of by the means at their command.

E. E. Lothrop, City Manager, Coraopolis, Pa., reports very light snowfalls, never exceeding 6 in. and that only twice a year, and the only municipal equipment three home-made V-shape sidewalk plows.

J. N. Murdock, Mayor, Durham, Ontario, Canada, reports that his town only cleans the main streets in the business section, and that for this purpose the only equipment used is a snow plow of the V type, the work being done on a contract basis.

J. A. Gallagher, City Manager, Hardwick, Vt., reports the use of hand shoveling methods and team haulage, at the cost of about $120 a year. The same sort of methods are reported from Hoisington, Kans., as well as from Strasburg, Va. Many other communities have written to say that snow removal is not in their program except that property owners are required to remove the snow from their own sidewalks.

California Has No Snow!

The Secret Is Told—The Mystery Solved—The Cause for the Winter Exodus to That State Is Their Lack of Winter, and of Snow

And now while we, here in this frozen region east of the Rockies and North of the Cotton Belt and other Southern points, are involved in the annual battle against snow and ice, and are trying to keep our streets and highways open in spite of the howling blizzards and drifting snows, the municipalities out on the west coast are evidently picking oranges from the trees and—say it with all respect, and quietly too, cooling the heated palate with tall, frosty, glasses in which the ice clinks merrily. For California has no winter, and therefore no snow! Their snow removal methods must be good, for they have no snow!

Let us, then, give thought to that ideal situation, and learn from them.

Walter J. Balaam, City Clerk, City of Redondo Beach, Calif., reports as follows:

"California is a land of absolute sunshine and red roses, and the only snow that the residents of this state see is that produced by the iceman, however, there is portions of this state wherein one can find snow during certain portions of the year, I am referring to the higher mountains in this territory, so you can safely figure that it is not a proposition here to remove snow and ice from the sidewalks and streets, but rather to remove snow and ice for the natives to gaze upon.

"You state in the first paragraph of your letter that there is only one correct solution to the snow problem, and at this time I am prepared to absolutely agree with you, also in the second paragraph you ask 'What is the best way to remove snow' and as a suggestion I will at this time state that the problem is not to remove the snow from yourself, but to remove yourself from the snow, in other words the real solution of the snow and ice question is to remove yourself to California and live happily ever afterwards, (No, this is not a bedtime story.)"

And now comes H. K. Brainerd, City Manager, City of San Rafael, California, who also seems to have hit upon the best solution of all, if we are to judge from his letter.

"The last snow storm here occurred some five years ago and we were able to dispose of the entire fall by vigorously throwing snowballs at anything that moved. This consumed the better part of three days, counting what snow was imported into town in boxes, etc. On the last day the majority of missiles contained inferior substitutes such as small rocks and other debris, and we were unable to maintain the standard of color, which we understand is pure white.

"As to the volume of work handled per hour would state that it varied greatly, bankers, golfers and the like having even a better record than common labor.

"No true statement has ever been rendered on snow removal costs, but considering broken windshields, lost teeth, harrowed feelings, etc., we feel that we should by no means sponsor annual storms.

"Should any of your correspondents feel discouraged in the least in their search for the best and cheapest method of snow removal or should they decide that there wasn't any, please feel free to invite them to San Rafael, California."

Similar good news comes from R. A. Watkins, City Manager, City of Pittsburg, California, who writes: "I would be pleased to give you a detailed cost of removing snow from our city streets if we could ever trace back in history and find where there was such a catastrophe. However we have on hand an abundance of sunshine and if when some of those rainy days set in back east you would like to have a barrel of it, if you will wire me I will see that you get an ample supply as we have almost 365 sunny days per year, and have never seen a piece of ice in town other than artificial.

"I hope that this will assist some city managers to 'get next to themselves' and come West where God intended for men to live."

Next we hear from C. L. Nichols, City Engineer of Azusa, Calif., who gives us the following picture:

"The best way to remove the snow that soon will be a continual or frequent problem on our streets and sidewalks. That's a good laugh for a Southern California City Engineer. The best way that I found while being in Lincoln Nebraska to get the snow off my front sidewalk quickly was with a 2 by 2 light wooden shovel 'snow plow' that I made myself, it beat the old iron spade all hollow; but to get rid of snow 'all together' I had to come to Southern California, where the only snow I can see is above the orange groves and rose trees 10,000 feet above sea level on the top of 'Baldy' or Mt. San Antonio; (while I am sitting in my shirt sleeves.)"

Then comes a similar statement from W. F. Luning, City Engineer, Red Bluff, Calif., and who holds the same office in Corning, Calif., as well, informing us as follows:

"We have no snow to remove. Some seasons we get 2 or 5 inches. This is mostly used up snow falling or rolling into snow images. In some instances they sprinkle the snow with salt to melt it from the walks. But back there in the East it would take a lot of salt.

"We have no snow to move from our streets. If 6 inches of snow falls they employ men to shovel it off of the roofs in some cases."

And then when you hear testimony from a number of other California cities to the same effect; namely. "We have no snow!" there can be but little doubt that the inhabitants of this state have absolutely solved the snow removal problem simply by removing themselves from the snow instead of removing the snow from themselves.

Unfortunately, the entire country cannot follow their example.

Airport Lighting

A Paper Presented Before the Society of Automotive Engineers, New York City, Oct. 19, 1927

By H. E. MAHAN
Illuminating Engineer, General Electric Company

Fig. 1—Revolving Beacon

The success of commercial aviation demands that operations be continued throughout the hours of darkness and in providing artificial light during this period that no added hazards be introduced to interfere with the safe and practical conduct of the port activities. The author approaches this problem from the viewpoint of the engineer, relying on the aviator to contribute his experience in establishing requirements and judging the effectiveness of the facilities provided. In this connection it is quite in order to pay tribute to the efficient service rendered by the Army, Navy and Department of Commerce Aeronautic Bureaus in functioning as a clearing house for data and establishing working standards found best by practice. In this way the practice in the lighting of airports follows rather definite principles which is highly desirable, for in this way all airports will have a familiar appearance from the air at night and the pilot landing at a strange port will not be confused by novel or unfamiliar lighting features.

The lighting facilities considered essential at an airport for safe and efficient night operations are these:

(1) An airport beacon.
(2) Boundary lights.
(3) Field floodlighting.
(4) All illuminated wind direction indicator.
(5) Obstruction lights and airport lights.
(6) Ceiling projector.

Beacons.—The beacon is intended to indicate the location of the airport from distant points. A beam of several million candlepower has been found desirable for this purpose and in order that it may be visible from all directions, the beacon is revolved, giving the effect of a flashing light from any one point. A typical form of revolving beacon is illustrated in Fig. 1 and consists of a 24 in. parabolic glass mirror, in the focus of which is placed a 900 watt, T-20, 30 volt or a 1,000 watt, 110 volt, T-20 Mazda lamp. The former lamp having a more concentrated filament than the latter, delivers a higher beam

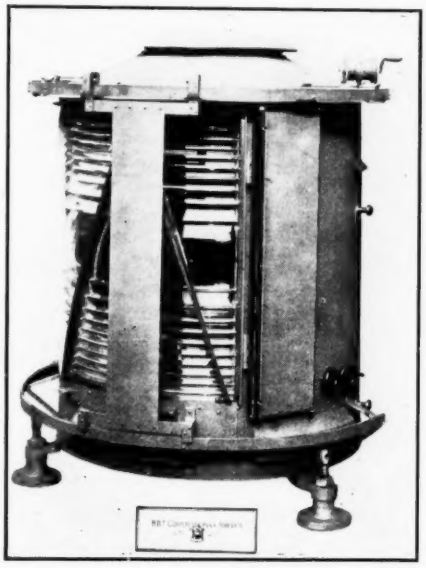


Fig. 2—Large Airport Floodlight with Arc or Incandescent Lamps

candlepower (approximately 8,000,000 as against 2,300,000) and is, therefore, preferable for this class of service. The electric service at most airports is a. c., which makes it convenient to operate the low voltage lamp by means of a transformer. The practice is to place the beacon on a steel tower, 50 to 75 ft. high, or on the top of a hangar or other building in order to increase its range of visibility. The beam is elevated approximately one-half of its width above the horizontal which places the lower edge of the beam on the horizontal, i. e., a 3 deg. beam would be elevated 1½ deg. above the horizontal.

Where beacons are placed at remote locations along the airways it is customary to equip them with automatic lamp changers which place a new lamp in the focus in the event of a lamp failure. This is not considered necessary at terminal ports where attendants are present to maintain the equipment.

Boundary Lights.—Upon his arrival over the field, the pilot is made aware of the shape and extent of the field by means of boundary lights. These lights are usually of 600 lumen (60 c-p.) size, spaced on 200 ft. to 300 ft. centers, and operated from a series circuit; this form of distribution is more economical for the length of runs necessary for most fields than the multiple distribution, although the latter system is sometimes used. The series circuit is fed from a constant current transformer (primary voltage 2,200 to 2,400) delivering 6.6 amps. constant current and remotely controlled through an automatic controller by a push button at any convenient point on the field. In this way the hazard of manually switching a high potential circuit is avoided.

The distribution system consists of No. 8 AWG parkway cable. This cable is rubber insulated, lead sheathed and steel armored and is buried directly in the soil about 12 in. deep. It is brought up to the boundary light through pipe as shown in Fig. 9. In some cases individual boundary lights are operated from a series multiple transformer located at the base of the pedestal, the primary of which is connected into the series circuit. This method is shown in Fig. 6 and offers the advantage of keeping the voltage above the ground down to a safe limit so that in case a

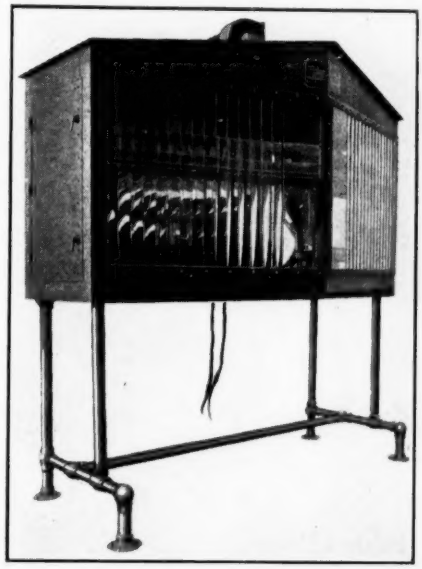


Fig. 3—Large Airport Floodlight Using Two Incandescent Lamps

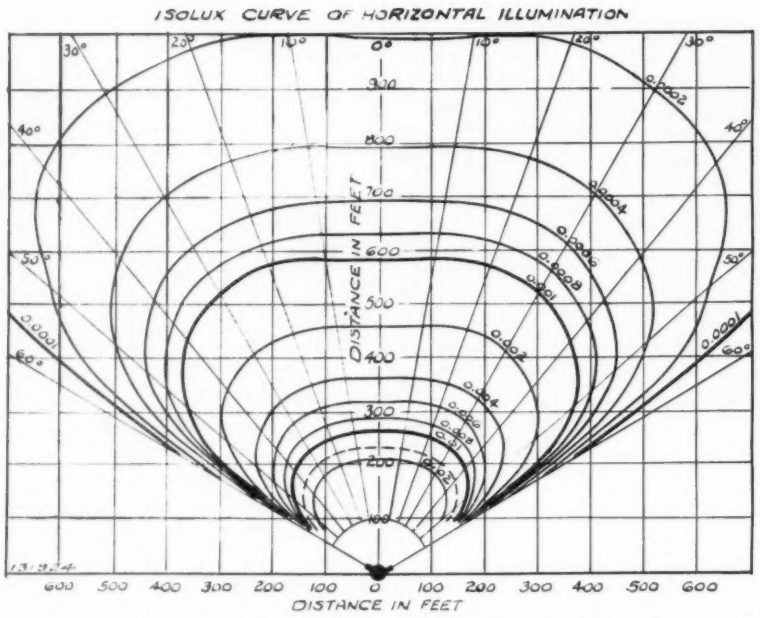


Fig. 4—Distribution of Horizontal Illumination from the Small 120 Field Light Shown in Fig. 11, with 1000 watt, 115 v., T-20 Lamp.

plane collides with a boundary light fitting the likelihood of fire or injury to life or property is minimized. Where the units are operated directly from the series circuit, an automatic cutout should be provided to maintain the continuity of the circuit in the event of a lamp failure. The boundary light is supported by a pipe imbedded in concrete or otherwise made rigid and elevated in general about 3 ft. above the ground. The unit itself consists of a weatherproof casing supporting a clear or prismatic glass globe in which the lamp is enclosed. Typical forms of boundary lights are shown in Fig. 9.

Obstruction and Approach Lights.—Buildings, pole lines, radio towers, etc., which are within the gliding distance of the field are regarded as obstructions and are marked with a red light installed at the highest point of the obstruction and visible from all sides. A unit of similar construction to the boundary light is used for this purpose except that it is equipped with a red globe and because of the absorption of light in the red glass, a lamp of at least

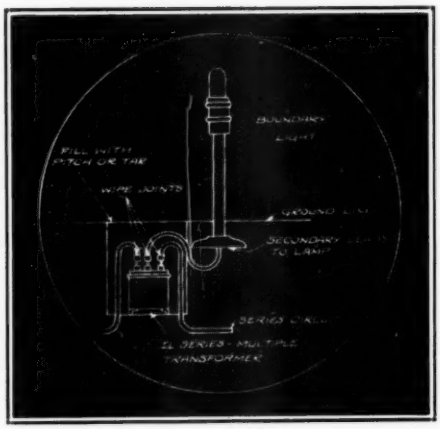


Fig. 6—Boundary Light with Individual Series—Multiple Transformer.

1,000 lumens (100 c-p.) is used. A green globe on this same unit indicates an approach light which enables the pilot to line up his plane with the runways or with the most favorable landing area on the field. The application of obstruction and approach lights is apparent from the diagram in Figs. 10 and 12.

It is sometimes found more practical to make obstructions visible by floodlighting them, which method has the added advantage of assisting the pilot in estimating his altitude. Where this system is employed, care must be exercised in locating the floodlighting pro-

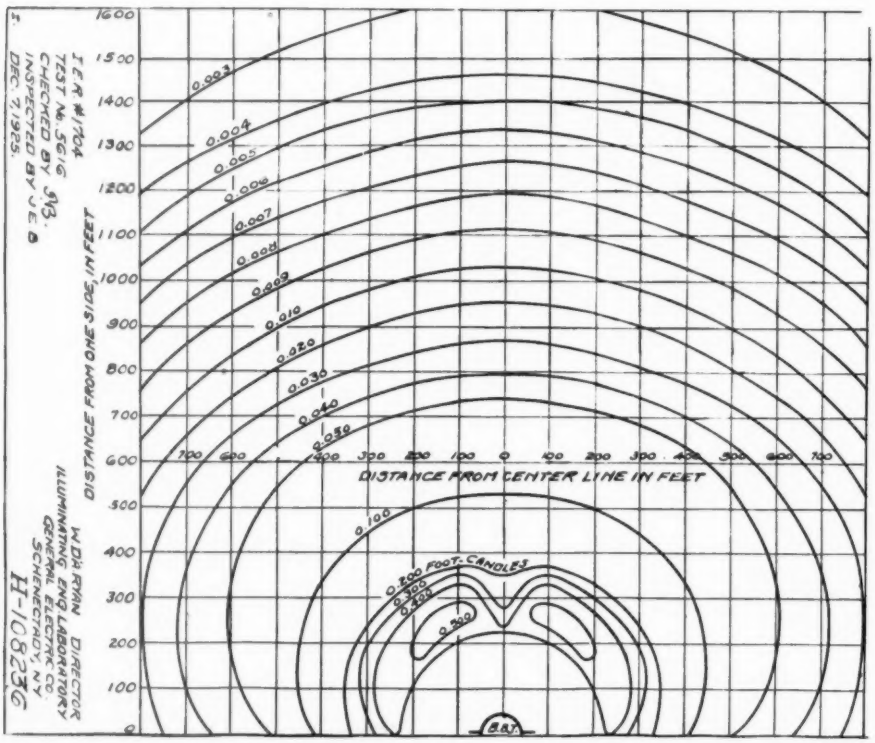

DISTANCE FROM CENTER LINE IN FEET
DISTANCE FROM ONE SIDE IN FEET
100 FOOT-CANDLES
W. D'A. RYAN DIRECTOR ILLUMINATING ENG. LABORATORY GENERAL ELECTRIC CO. SCHENECTADY, N.Y.
H-108236

Fig. 5—Distribution of Horizontal Illumination from Large Airport Floodlight Shown in Fig. 2, with 150 amp., 110 v. High Intensity Arc.

Fig. 7—Incandescent Searchlight Used for Determining Ceiling

jectors to avoid glare in the eyes of the pilots.

Field Floodlighting.—The general illumination of the field is a very important feature of the lighting, for upon it depends the pilot's knowledge of the field terrain. Every facility should be provided to enable pilots to take off, land and manoeuvre safely and with the increasing size of planes and the inauguration of passenger service, the need for adopting every safeguard becomes increasingly greater.

The successful lighting system for an airport should be adequate in intensity and free from glare, it should be fairly uniform over the active area of the field and be distributed in such a way as to avoid objectionable shadows. There are two general methods of lighting the field, viz., (a) by a centralized light source consisting of a large unit, or (b) by distributed light sources of relatively smaller capacity. Units of the former class are available in both arc and incandescent types. A typical form of the former is illustrated in Fig. 2 and consists of a 180 deg. sector of a Fresnel lens composed of 21 elements. The lens is 3 ft. 6 in. in height and 4 ft. 8 in. in width with a focal length of approximately 20 in. The lens is mounted in a ventilated weatherproof housing in which is also placed a 150 amp. high intensity arc mechanism. This unit delivers a fan of light of approximately 180 deg. spread in the horizontal plane and 2 deg. in the vertical. The distri-

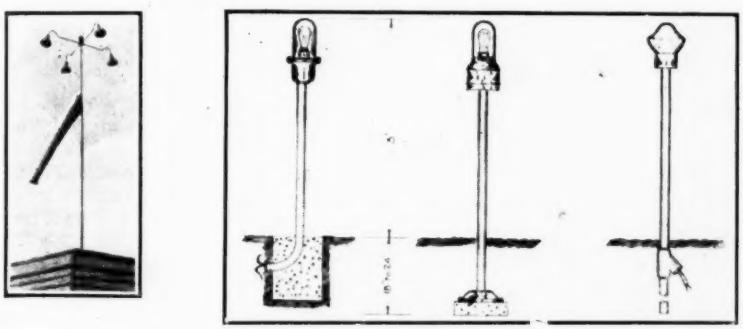


Fig. 8—Left—Wind Cone with Lighting Equipment; Fig. 9—Right—Typical Forms of Boundary Lights.

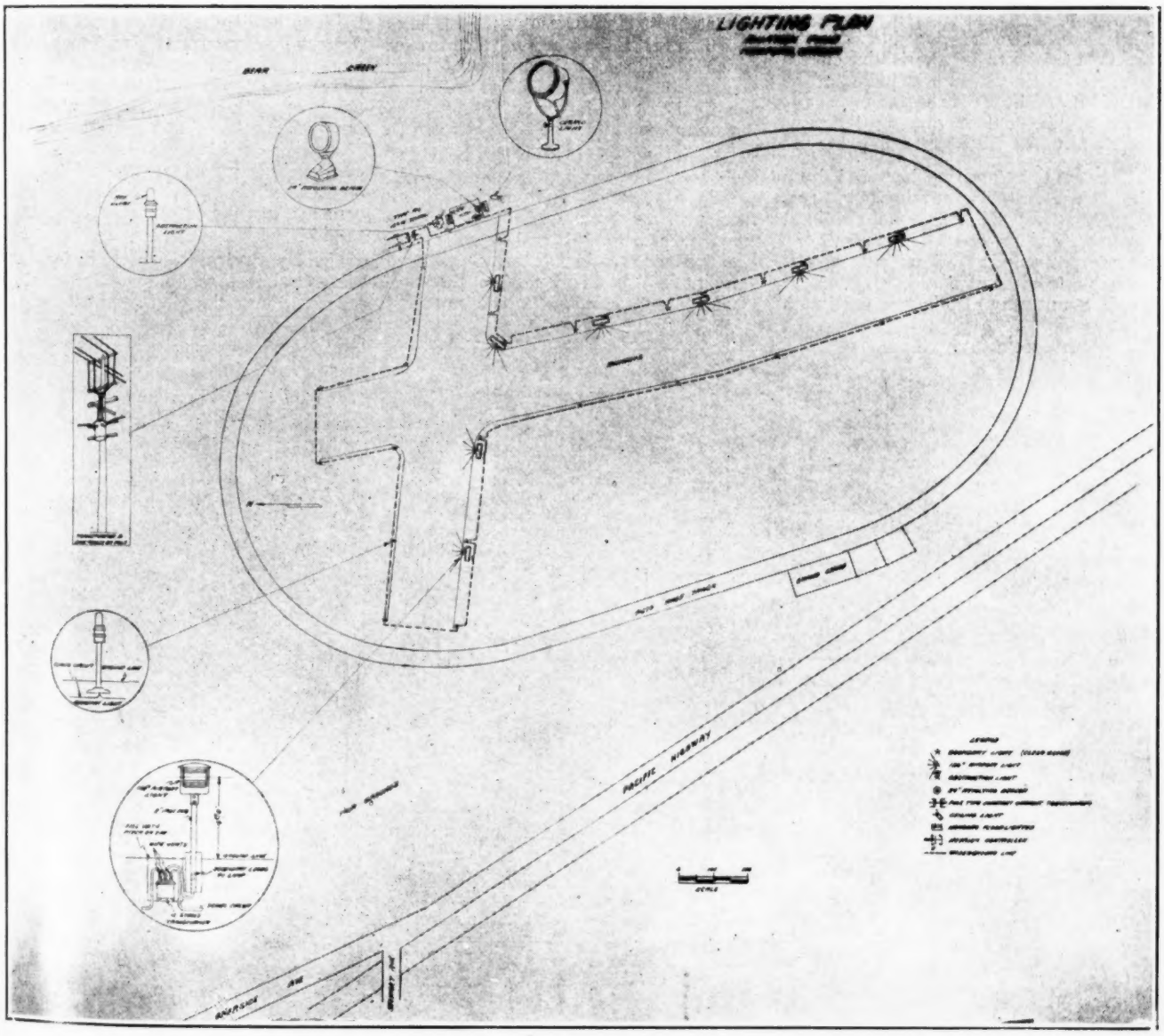


Fig. 10—Airport Lighting Plan as Used at Medford, Ore., Showing the Distributed System of Field Illumination

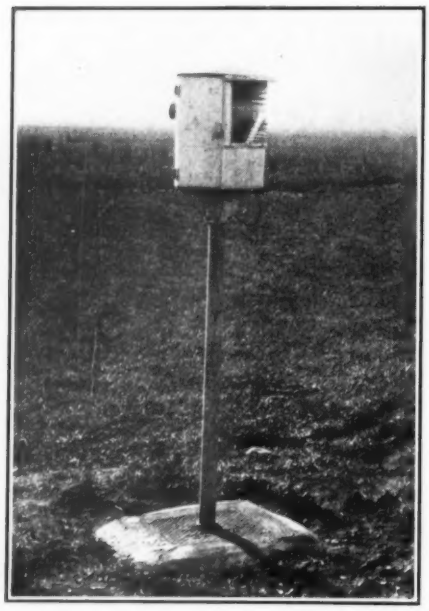


Fig. 11—120 Deg. Aviation Field Light

bution of horizontal illumination over the field is shown by the isolux curves in Fig. 5. These curves indicate the illumination in foot candles on the plane of the field at varying distances from the unit.

This unit is usually installed in a shed and elevated approximately 10 ft. above the field. The arc requires direct current for its operation and it is, therefore, necessary, where only a. c. is available, to install a motor generator set. The unit may also be equipped with a 10 kw incandescent lamp in place of the arc mechanism, permitting its use on either alternating or direct current.

A form of unit using incandescent lamps and designed for the centralized system of lighting is the airport twin floodlight (Fig. 3) employing two 5 or 10 kw incandescent lamps. Each lamp is placed in the focus of a 24 in. mirror and diverging glass strips comprising the front of the housing spread the beam in the horizontal plane. The distribution of light is in the form of a fan with approximately 90 deg. spread in the horizontal plane and 6 deg. in the vertical plane. By means of a time relay and contractors, the two lamps are first thrown on the line in series and after a period of 30 seconds placed in multiple across the line (110-120 volts). This prevents damage to the lamp filament which is likely to occur if lamps of this size are subjected to full voltage at the start.

A form of unit in use for the distributed system of lighting is shown in Fig. 11 and consists of a small 120 deg. Fresnel lens approximately 8 in. high and 6 in. radius at the focal point, of which is placed an incandescent lamp of from 900 watts to 1,500 watts. A spherical mirror is also placed behind the lamp to gather the light thrown to the rear and direct it in a useful direction.

This system of lighting is usually employed for the illumination of runways (see Fig. 10) and small fields. The units are in general operated through a transformer from the constant current boundary light circuit and spaced on 200 ft. to 300 ft. centers. The illumination on the plane of the field from a single unit is shown in Fig. 4.

All of the above systems of field illumination are found appropriate under certain conditions. A careful survey should be made of local conditions and requirements to determine the system best suited. Just what intensity of illumination is desirable has not been definitely determined to the satisfaction of all parties concerned, but prevailing practice indicates that a value of approximately .25 foot candles (average vertical illumination) is found satisfactory. Our experience in this field is relatively limited, but data are accumulating very rapidly and along with it definite standards of practice.

Illuminated Wind Direction Indicator.—It is essential that the pilot of a plane know the direction of the wind on the ground when he is to land. The customary device used for giving him this information is the cloth cone shown in Fig. 8. At night this is illuminated by deep bowl porcelain enamel steel reflectors arranged on four brackets 90 deg. apart and approximately 6 ft. above the cone. Each reflector is equipped with a 100 watt Mazda lamp. An obstruction light surmounts the wind cone structure. Other devices are employed to give the pilot information on the wind direction, but the wind cone is perhaps the most generally used.

Ceiling Projector.—Observations are made at airports and the information transmitted to interested parties of the

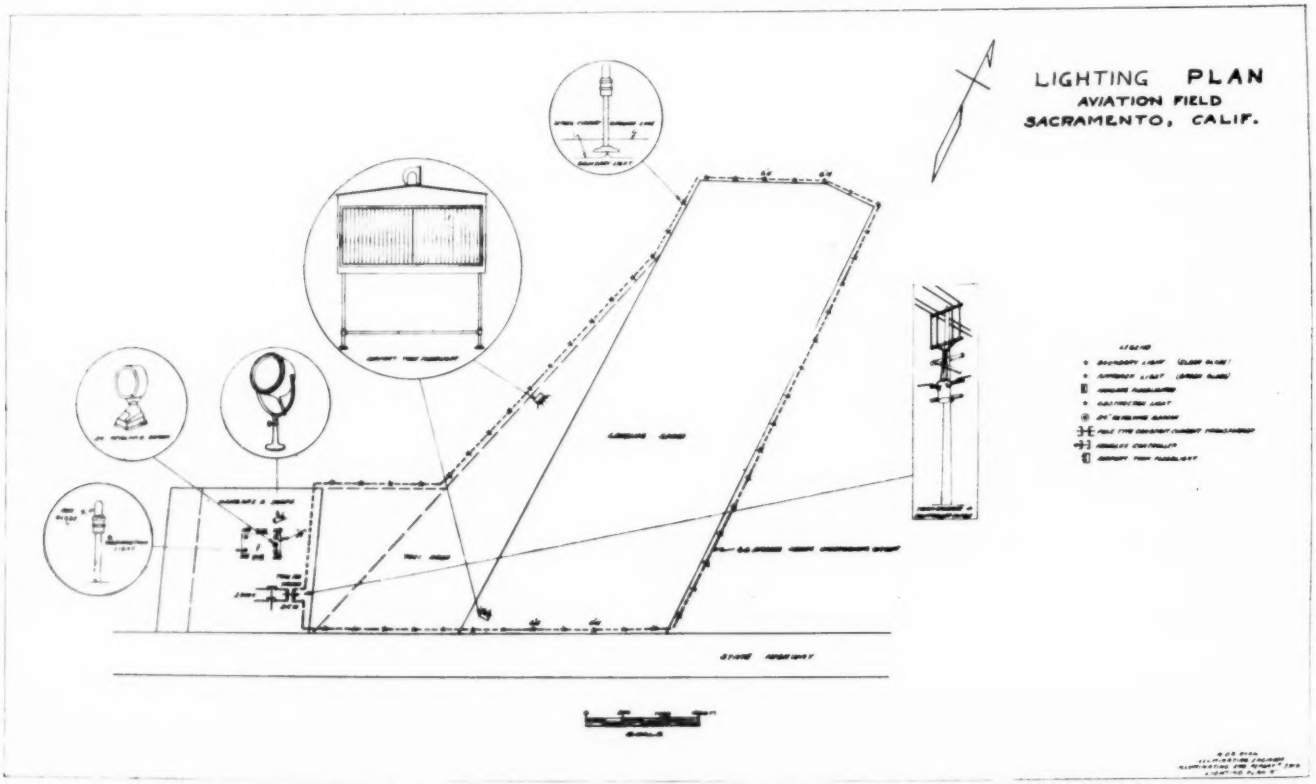


Fig. 12—Airport Lighting Plan as Used in Sacramento, Calif., Showing the Centralized System of Field Illumination

height of the clouds (ceiling) above the ground. This is a measure of the visibility from the air and is very useful information. A ready means of determing this information is by means of a narrow beam of light projected toward the clouds at an angle of 45 deg. Pacing off the distance from the light source to the point directly beneath the spot it makes on the clouds gives the height above the ground of the clouds; that is, the height of the ceiling. Fig. 7 illustrates a 12 in. incandescent searchlight which when equipped with a 500 watt, T-20, 110 volt Mazda lamp delivers an 8 deg. beam of 400,000 candlepower and is frequently used for this service.

Lighting Layouts.—Figs. 10 and 12 indicate typical airports employing the two systems of field lighting referred to previously. The former is equipped with the centralized system of lighting, two units being available and the one used which is most favorable for the prevailing wind; the latter the distributed system with the illumination confined to the runways. The arrangement of boundary lights, obstruction lights, approach lights, beacon, etc., on these plans is typical of present day practice.

Financial Statistics of City Governments, 1926

The U. S. Department of Commerce announces a summary of the financial transactions of the 250 cities having a population of over 30,000 for the fiscal year 1926.

The total payments for operation, maintenance, interest, and outlays for permanent improvements for cities having over 30,000 population were 89.1 per cent more than similar payments of the government of the 48 states, and those for the Federal government were only 10.4 per cent greater than those for the 250 cities for the fiscal year 1926.

Expenditures.—The payments for operation and maintenance of the general departments of the city governments of the 250 cities for the fiscal period 1926 amounted to $1,639,281,156, or $39.18 per capita. In 1925 the comparative per capita for operation and maintenance of general departments was $37.43, and in 1917, $19.07. Payments for the operation of public service enterprises, as water works, electric light plans, and similar enterprises, amounted to $156,401,974; interest on debt, $293,518,886; and outlays for permanent improvements, including those for public service enterprises, $963,443,480. The total payments in 1926, therefore, were $3,052,645,496; in 1925, $2,911,990,960; and in 1917, $1,108,021,565.

The per capita net governmental-cost payments for operation, maintenance, and interest for 146 cities covered by the various census reports since 1903 were $50.30 in 1926, $47.87 in 1925, $24.58 in 1917, and $16.41 in 1903.

The totals include all payments for the year, whether made from current revenues or from the proceeds of bond issues. Proceeds from the issuance of debt obligations are not considered revenue receipts.

Of the 250 cities covered by this report only three were lacking in revenues sufficient to meet all operating expenses and interest, while 74 realized enough revenues to meet all their payments for expenses, interest, and outlays and to have a balance available for paying debt.

Of the total municipal payments in 1926, 53.7 per cent was for operation and maintenance of general departments; 5.1 per cent, operation and maintenance of public service enterprises; 9.6 per cent, interest on debt; and 31.6 per cent, outlays for permanent improvements.

Of the payments for operation and maintenance of general departments 38.3 per cent was for education; 20 per cent, protection to person and property; 9.3 per cent, highways; 8.5 per cent, general government; 7.6 per cent, sanitation or promotion of cleanliness; 5.8 per cent, charities, hospitals, and corrections; 4.7 per cent, miscellaneous; 3.4 per cent, recreation; and 2.4 per cent, conservation of health.

The percentages for 1926 show but little change from those for 1925, the largest in each of the years being for education and the smallest for conservation of health.

Of the total payments for outlays for permanent improvements, the principal items were $332,249,611, or 34.4 per cent, for highways; $212,207,706, or 22.0 per cent, for education; and $176,109,577, or 18.3 per cent, for public service enterprises.

Revenues.—The total revenue receipts of the 250 cities for 1926 were $2,738,961,362, or $65.46 per capita. This was $649,759,346 more than the total payments of the year exclusive of the payments for permanent improvements, but $313,684,134 less than the total payments including those for permanent improvements. The revenue receipts included $1,747,163,136 from general property taxes; $70,474,422 from special taxes; $78,158,791 from licenses; $204,902,053 from special assessments; $134,103,970 from subventions, donations, and pension assessments; $126,482,067 from interest, rents and highway privileges; $281,042,521 from earnings of public service enterprises; and $96,634,402, the remainder, from poll taxes, fines, forfeits and escheats, and earnings of general departments.

The per capita net revenue receipts of 146 cities covered by the various census reports were $66.14 in 1926, $61.90 in 1925, $31.97 in 1917, and $21.14 in 1903.

Indebtedness.—The net indebtedness (funded or fixed debt less sinking fund assets) of the 250 cities amounted to $5,122,141,752, or $122.42 per capita in 1926, this being an increase of 9.9 per cent over that for 1925. The per capita net debt of 146 cities covered by the various census reports was $128.13 in 1926, $119.45 in 1925, $80.75 in 1917, and $44.71 in 1903.

While there was an increase of $462,512,518 in net debt for the 250 cities as a whole, 84 individual cities showed a decrease in their net indebtedness.

A comparison of the aggregate increase in net indebtedness with the total payments for outlays discloses the fact that 48 per cent of the permanent improvements for 1926 were financed from proceeds of bond issues.

Assessed Valuations and Tax Levies.—For 1926 the assessed valuation of property subject to ad valorem taxation for city purposes was $68,004,953,929 for the 250 cities having over 30,000 population; and the amount of taxes levied for the city government was $1,847,699,255, or $44.16 per capita.

Desirability of Uniform Classification.—Financial statistics of the cities having a population of over 30,000 have been collected since 1903, but because of the diversified accounting systems in 250 cities in this class it is still necessary to have agents visit most of these cities to prepare the reports.

The Bureau of the Census advocates a simple, logical, and comprehensive classification of accounts, the use of which would permit obtaining readily accurate and comparable data. It requires only that the accounting official segregate receipts and payments under proper headings, showing the sources of revenue and the objects of expenditure. This can be done in any city without changing the present system of accounting.

The cooperation of city officials in establishing a uniform classification of accounts would make it possible for the bureau, without greatly increasing expenditures, to collect statistics on this important subject for practically all cities in the United States.

Roadside Tree Planting

How California Makes Provision for Public Utilities Told in California Highways

The Maintenance Department of the Division of Highways of the State Department of Public Works of California, has under its supervision all matters relating to permits for work or encroachment on the state highways. Some 4,000 permits were issued during 1926, the cost of special investigation by the district offices and necessary detail being $13,000. The limitations imposed by these permits on overloads and private encroachments insure a protection to the highways and their development which amply justifies the expense involved.

Regulations governing the placement of roadside trees and public utilities are of particular interest, presenting as they do a conflict of the aesthetic and commercial when located within narrow rights of way.

685 Miles of Highways Planted.—Many individuals and organizations have interested themselves in highway beautification, some 685 miles of highways having been planted with roadside trees, the annual cost involved in their care and replacement representing an expenditure of 2 cents of each dollar appropriated for general maintenance work.

The highway right of way is also considered the natural location for utilities as service can be furnished with a minimum of extension lines and the cost of private right of way need not be added to the established rates.

The success of the tree planting movement, however, has placed a burden on the pole line companies, as the earlier plantings have reached sufficient height to interfere with wires and cause "cross-talk" on the telephone and electric disturbances on the power wires. To avoid topping or cutting unsightly notches through the trees, it is necessary either to raise the wires on longer poles or to move the lines. The public utility companies appreciate the value of the trees and generally where trimming has been permitted, the work is satisfactory. However, occasionally through carelessness, an unsightly job is done and the public's immediate protest indicates their active interest in roadside trees.

Assignment of Definite Locations.—To minimize this conflict and satisfy both, from an aesthetic and economic view, at the same time provide for the future development of the highways, it was necessary to assign some definite location within the right of way to the trees, poles and service utilities. Placing trees too close to property lines has often resulted in damage to them from the stock within the adjacent fields. Proper cultivation and protection from fire is also hampered by too close proximity to property lines, and the cost of watering increases when trees are located beyond the reach of our one man tree watering units. Placing poles along the tree line means interference with proper tree growth and, due to continuous trimming for wire clearance, handicaps growth and development of the trees.

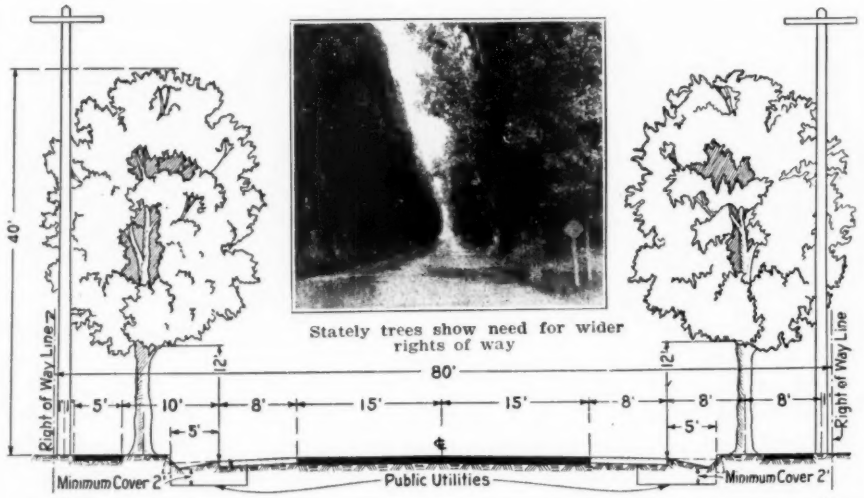
For these reasons it was decided to place the poles at the right of way line and the trees adjacent to the curb line. The trees at the future curb line will in time present a vista of green banked foliage restful to the eye of the motorist and to a large extent hiding the unsightly poles.

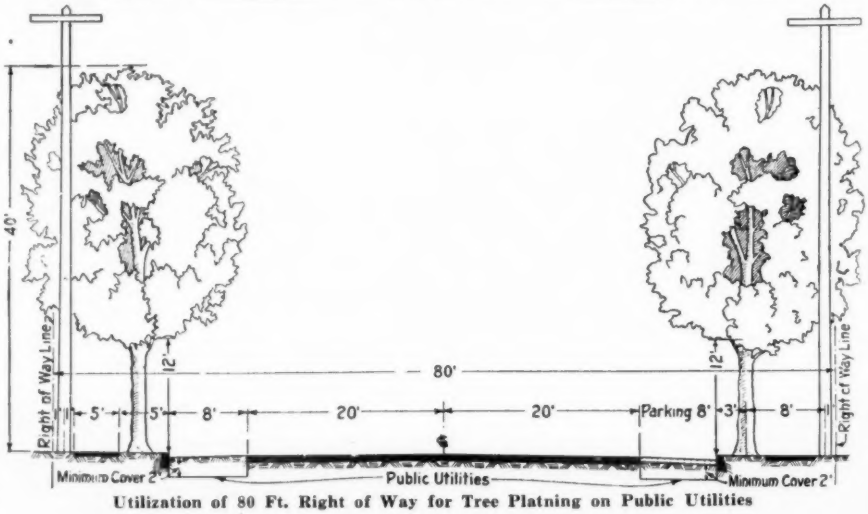
The location and maintenance of pole lines within the highway right of way and their interference with trees was recently the subject of a thorough discussion before the Highway Commission and the Director of the Department of Public Works by a committee representing practically all of the public utility companies of the state. The conclusion reached substantiated the policies of the Maintenance Department.

The drawings shown represent the proposed ultimate sections for 2 and 4 way traffic lanes for 80 ft. width of right of way. In effect, they reserve on an 80 ft. right of way a clear zone of 56 ft. between curbs for road purposes, the remaining space being available for trees, pole lines and sidewalks for pedestrians.

Some Wisconsin Concrete Paving Records.—A new record for concrete road construction in Wisconsin is reported to have been made during the past season by the E. W. Hallett Co., Crosby, Minn. This firm placed 1,666 lin. ft. of 20 ft. concrete in 13 hours and 50 minutes, with a 32-E 9-bag batch concrete mixer and also established a record with 6,602 lin. ft. for the weekly high run. The 1926 record for concrete paving had previously been broken during the season with runs of 1,355 ft. and 1,526 lin. ft. in 14 hours and 17 hours, respectively, by the Kramp Construction Co., Berlin, Wis., and a run of 1,363 lin. ft. in 15 hours by the Schuster Construction Co., Denmark, Wis.

Stately trees show need for wider rights of way





Utilization of 80 Ft. Right of Way for Tree Platning on Public Utilities

Street Cleaning Activities

The Advantages of Training and Personnel Discussed in Paper Presented at 1928 Conference of International Association of Street Sanitary Officials

By J. P. SODERSTRUM
City Manager, Rapid City, S. Dak.

The Municipal Pay Roll and Political Pets.—The slogan of the taxpayer, the whole country over, has become "Economy." Upon us as officials representing these taxpayers, therefore, falls the duty to overcome as many of the obstacles set up by politics, ignorance or inefficiency as possible, and to obtain and maintain a personnel of our departments, with such qualifications that we can make up some of our lack of finance by building up efficiency, and thus making economy our goal also. We are thankful to say that the day of using municipal payroll for a parking place for old political pets and pensioners, is rapidly leaving us. The slogan "Efficiency" has been gaining ground rapidly and, we might truthfully say, has become the honest platform of many of the later day politicians. This demand for efficiency has practically revolutionized a great many of our methods in municipal work and is gaining results unthought of several years ago. Nevertheless it is up to us, as heads of our various departments, to endeavor to continue to make our forces more and more efficient. To do this we must first attempt to build up a personnel within our own organization, which will come as close as possible to the ideal. The qualifications of such an organization may be substantially outlined in the following paragraphs:

The aim of every organization, whether private or public, in the army or in civil life, is to obtain the highest degree of efficiency for their organization. Upon the individual men within this organization, as well as the head of the same, falls that burden. Each individual must do his own duty well and efficient. By so doing, it is the very natural assumption that economy will follow.

Discipline Basic Training.—The army claims that the most important basic training of the men, from enlistment to retirement, is that of "Discipline." This has been defined as the "cheerful, willing and prompt obedience to all lawful orders from their superiors." Can we not also claim this to be the foundation for training of men in our organizations as well? No organization can function properly if any part of the same fails to carry out the orders of its superior officer, and do so thoroughly and promptly. This superior officer may be called a straw boss, foreman, superintendent, manager or commissioner. It really makes no difference as to his title, but in any organization, some one man must be vested with the authority to pass on these orders or instructions. Our own departments may be subdivided into two or more parts, each dovetailing more or less with the other. If any one of these units fails to carry out its orders or instructions at the proper time, it may result in the other unit being held up, or its work enlarged. For this reason can we not say that discipline is also our first great problem to inaugurate and maintain in our own organization. Each individual laborer may be classed as a link in the chain which represents the strength of our whole department. If one of these links fails to hold up his end of outlined work, it is bound to effect the whole chain, in its attempt toward efficiency.

Great strides have been made in recent years, by the invention and use of machinery, which has taken the place of individual laborers who have previously worked with primitive, crude and slow methods. These machines have accomplished many times better work with greater efficiency and less cost than that done by hand labor.

Even with these new methods, however, it has been necessary to employ a certain amount of labor, both skilled and common, for try as we will, we must still use white wings, operators and other labor supplementary to the use of these machines. It is the training of this labor, that brings to us the study of the qualifications of the personnel necessary within the organization. This is our biggest chance to work toward efficiency.

Loyalty to the Organization.—Next to the importance of discipline within the organization, is that of loyalty to it and to the head of the department. No man is going to give the best that is in him, unless he is loyal to his own organization. He may not like the officers directly over him, nevertheless, he should be broad enough not to allow this to affect his work, or enter into the performance of his routine duties for which he is hired, and for which he receives his pay. As long as he is getting fair compensation or the sum that was agreed upon when going to work, he should "do his bit" by giving a full day's work, and a little more if possible, for his day's pay. By so doing he is not only contributing his own individual part toward a more efficient unit of the organization, but he is laying a foundation for his personal advancement as well.

Clock Watchers and Whistle Listeners.—Too many men have formed the habit of watching the clock, listening for the whistle or merely putting in time. A man who has this habit cannot and does not concentrate on his work, and therefore can not give all of his energy or attention to his work. He, therefore, is not loyal to his employer, for he is not as efficient as he might be if he did not have this habit. This holds especially true to machine operators and in machine operation.

Machines used in street cleaning work usually cost from $6,000 to $10,000. Competent, at many times, high priced, operators are therefore necessary for the operation of this equipment. It is customary in most cities using these machines to have the operators maintain and repair their own equipment. If this operator is loyal to his organization, and his heart is really in his work, he will take pride in his machine and form the habit of seeing to it that it is kept well oiled, cleaned and ready for work at any time called upon. This man then has become an asset to his organization. If, on the other hand, he is an operator who merely indifferently drives his machine, puts in the required number of hours, and is looking forward to pay day only, he usually does not care much whether it is kept in good condition or not. This operator will soon have a series of break downs, repair bills, poor work, lost time and large totals on the cost sheet, which condition we are trying to avoid.

Schools of Instruction.—Good results in this personal interest, or personal responsibility, phase have been secured by large manufacturers in various and numerous ways. Some of them hold schools of instruction for their men, finding that the results obtained thereby more than justified them in so doing. Some of these said schools are held during the working period, and some are held after working shifts, with extra compensation allowed the men for their time thus devoted. Some organizations are encouraging their men to purchase a few shares of stock in the company. Many even go so far as to demand that each employee hold some stock. In this way, they hope to build up a feeling of individual responsibility among the men, so that they feel that they are, in reality, working for their own personal interests, thereby benefiting from the dividend of profits derived from increased output. Other firms are working much along this same line, by offering a bonus at the end of the year. All this tends to show, that the employer of today has

realized that he must inculcate into the mind of the individual worker, this sense of individual responsibility.

While we can not sell our own subordinates, a block of stock in our municipality, nor even give them a bonus, we can conduct our departments in such a way as to make each and every man feel that he is an essential part of the chain making up the organization, rather than one of the cast off links. In so doing, we will have accomplished much toward bringing us one step closer to our goal.

Locating Men in Right Kind of Work.—One large manufacturer once claimed that he firmly believes every man has some nook assigned for him on this earth, if we can only find that nook. Why not help some of our men to locate their own nook. Some men dislike the work assigned them and cannot take an interest in it. They are too soon classified as failures and yet, somewhere in his makeup, he has a certain adaptability or hobby for a certain line of work. If we can switch these men around and find that particular job, we have again accomplished much for both our organization and the man. This condition may be true of some of the pets or pensioners we have thrust upon us, and which policy demands that we keep on the pay roll. A white wing may dislike to push a broom, while he may be happy in cleaning out a catch basin or some other job. If you can help to find the kind of a place that suits a man and if he likes his work, most of your troubles are over so far as that man is concerned, for if any man is put upon a piece of work that he does not like he cannot become interested in, he may as well be removed. He will always be a weak link in your chain. No matter how you order him about, or nag at him, he will not become efficient to any high degree.

Pick men who really like their respective jobs and it will be an easy matter to show him how to perform the details of the physical part of his labor. You will find he will be not only quick to catch onto the small tricks or short cuts necessary to further the best interests of his particular duties. He may even pick up some short cuts of his own which will work out to good advantage, and will always be trying to better his previous record.

Experience, the Great Teacher.—Do not expect to get men to come to you fully qualified for the position for which you desire them. There are many knacks and small tricks which we all learn from experience. These range all of the way from the correct way to hold a broom while pushing it, to managing the entire department. See to it that the individual understands some of the basic methods used and what results he is expected to obtain, or are desired of him. Give him such detailed instruction as he may need to start him off right on the performance of his duties. Give him an opportunity to get onto the hang of his job, or in other words, to learn to "know his ropes" and if he has these other qualities, he will soon produce the hoped for results.

Too many of us are inclined to forget that we, ourselves, once started from the bottom, and that we were also far from "knowing our ropes." Is it not fair then to give a helping hand to those beneath us? Some of us also are not entirely honest with our men, or our organizations, if we fail to pass on to them some short cut or to impart some new method that we have learned either from our own personal experience, knowledge gained from our associations, or from conventions attended by us, many of them at the expense of the municipality. Some, I am sorry to say, are too often reluctant to pass on this information for fear that it will better qualify one of the subordinates to fill our own position, thereby putting our own jobs in jeopardy.

The Importance of Organization.—We are, each and every one of us, placed in our positions to see to it that certain results are to be attained. To get these results and to be loyal to our municipality, we must have an organization under us upon which we can depend to do what is expected of them. To have such an organization, we must have discipline, loyalty to their organization and the full confidence of the men, each and every one of them. Let the men know that they will receive fair play at all times, for men who are in constant fear of being made the "goat," or do not have faith in their superiors, will not form such an organization.

If any one of the men comes to you with some pointers that he has picked up and really thinks they are to the advantage and betterment of the service that he is performing, do not laugh at him or jump onto him for suggesting such methods. He may be really honest and sincere in his idea. If he is wrong or his plan is not practical point out the errors in it and give him the reason therefor. He may bring in another idea that is really worth while, and which will become beneficial to the whole department.

The qualifications of the personnel of our street cleaning departments do not differ to any extent from those of the personnel of any other organization. The manufacturer is looking for men who will build up his organization into a smooth running and efficient human machine. The same is true of contractors, sales organizations, insurance companies and in fact any companies employing labor of any kind. All of these organizations are striving for efficiency which in turn produces the best results. If better results are obtained through the better personnel of these same organizations it must go without saying that better results, as as well as economy, will be obtained in street cleaning activities.

Smoke Studies

Smoke in the atmosphere, especially when combined with mist to produce fog, brings about a very great lowering of the daylight. At the present time a great loss of light results in large cities from the effect of smoke. A study of the decrease of light by smoke, now being made by the United States Public Health Service in New York City, at the lower end of Manhattan Island where the air is very smoky, showed an average loss of daylight due to smoke in January of 1927, on sunny days, of 42 per cent at 8 o'clock in the morning, and of 18 per cent at noon. These amounts of loss of daylight decreased, as the year advanced, to 33 per cent at 8 A. M., and 6 per cent at noon, in June. These figures are for clear sunny days; for foggy days, the loss is much greater. The loss of light due to smoke in the atmosphere is greatest early in the morning or late in the afternoon, and least at noon. As would be expected, the loss of light is greater in the winter than in the summer. The figures given show the great importance of getting rid of smoke in our great cities. Loss of daylight or the light rays, is not the only evil resulting from the presence of smoke in the atmosphere; smoke also cuts out to a much greater extent the ultra-violet rays which are so necessary for good health.

The amount of light reaching us at different times of the day, at different times of the year, and under different conditions of weather is of interest. Illumination is measured in a unit called the foot-candle, one foot-candle being the illumination on a surface at a distance of one foot from a standard candle. Records of daylight in Washington, D. C., have been made since July, 1924, by the United States Public Health Service. These records show that at noon on a bright day in midsummer the illumination seldom exceeds 10,000 foot-candles. In midwinter at noon on a bright day it seldom exceeds 3,500 foot-candles. The difference in illumination on sunny and cloudy days is illustrated by the average illumination for such days in December, 1924, and in June, 1925. In December the average illumination on cloudy days was found to be about 23 per cent of that on sunny days. In June this ratio was about 26 per cent. Great variations in daylight take place when small clouds pass over the face of the sun on a clear day. In such cases the light may fall from 9,000, or more, foot-candles to 3,000, or less in one minute's time, and return to the original amount during the succeeding minute.

Large increases of light may be produced by the reflection of light from banks of white clouds to the north of the sun, and very great decreases by the heavy clouds of thunderstorms.

Modern Equipment in Meriden, Conn., Filtration Plant

Automatic Proportionate Feeders and Other Up-to-Date Features Promise Economic Water Purification to Desired Degree with Uniformity and Economy

By C. PERRY PRANN
City Engineer, Meriden, Conn.

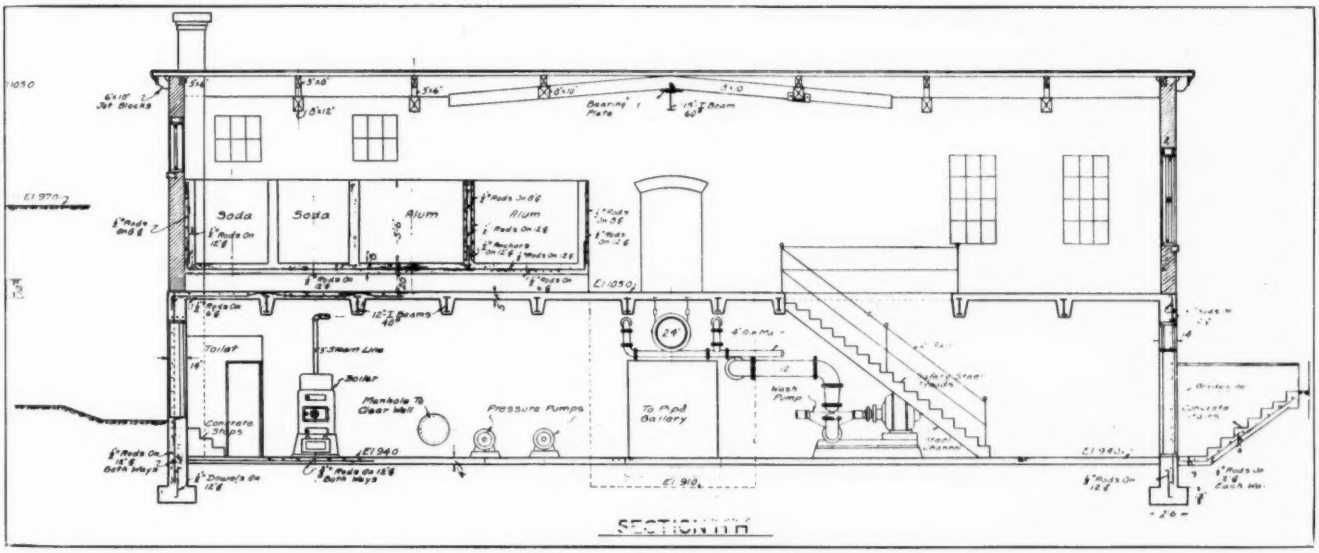
Prior to 1916, Meriden, Connecticut, a city of abut 40,000 population, received its supply of water from two sources, Kenmere and Merimere. Both reservoirs furnished water of good quality but insufficient in quantity during periods of dry weather. In October of the above year, Broad Brook, a newly constructed reservoir with an estimated capacity of 1,000,000,000 gal., was placed in service and water from this source turned into the city system. Since that time, Meriden's water supply has been subject to periods of objectionable color, bacteria and algae tastes and odors. This condition has been emphasized at such times as Broad Brook has been required to furnish more than its normal 1,000,000 of the city's 4,000,000 gal. per day consumption.

Meriden is now engaged in constructing a 5,000,000 gal. filtration plant for the Broad Brook supply, designed to allow for future additions to furnish up to 7,000,000 g. p. d. without an increase of pipe sizes. The new plant, constructed of concrete and brick, will consist of an aerator, two coagulation basins, pump room, chemical room, 6 rapid sand filters, pipe gallery, two filtered water storage wells and chlorinating equipment.

Water comes to the plant, by gravity, through a 30 in. main from the reservoir located about 500 ft. up stream, being returned to the same main, after purification, and continuing, by gravity, to a pumping station located about 800 ft. further down stream. Provision is made for by-passing the water, if it is desired to do so, but leakage of raw water through the by-pass is guarded against by double check valves with a 1½ in. bleeder pipe.

Aerator.—A 20 in. connection to the 30 in. main carries the water into the plant, through the pump room, to the aerator which is 32 ft. square and located over part of the coagulation basins, at sufficient elevation to provide gravity flow through the plant from this point. The four walls of the aerator are faced on the interior with white enameled brick, while free passage of air within is provided by louvres on three sides. Thorough aeration of the water is accomplished through a system of 76 2 in. Sprayco nozzles, each with a rated capacity of 50 gal. per minute. The nozzles are screwed into 6 in. laterals joined to a 20 in. main; the laterals being 3 ft. 6 in. apart and the nozzles 3 ft. 3 in. apart on the laterals. The elevation of the nozzles is approximately 107, while the elevation of the spillway at the dam above is 119. Allowing for a 0.3 ft. loss of head in the pipe from the dam, there remains an operating head on the aerator of about 11.7 ft. at high water. Provision is made for pumping the water to the aerator should the gravity head at any time drop to a point insufficient for satisfactory aeration.

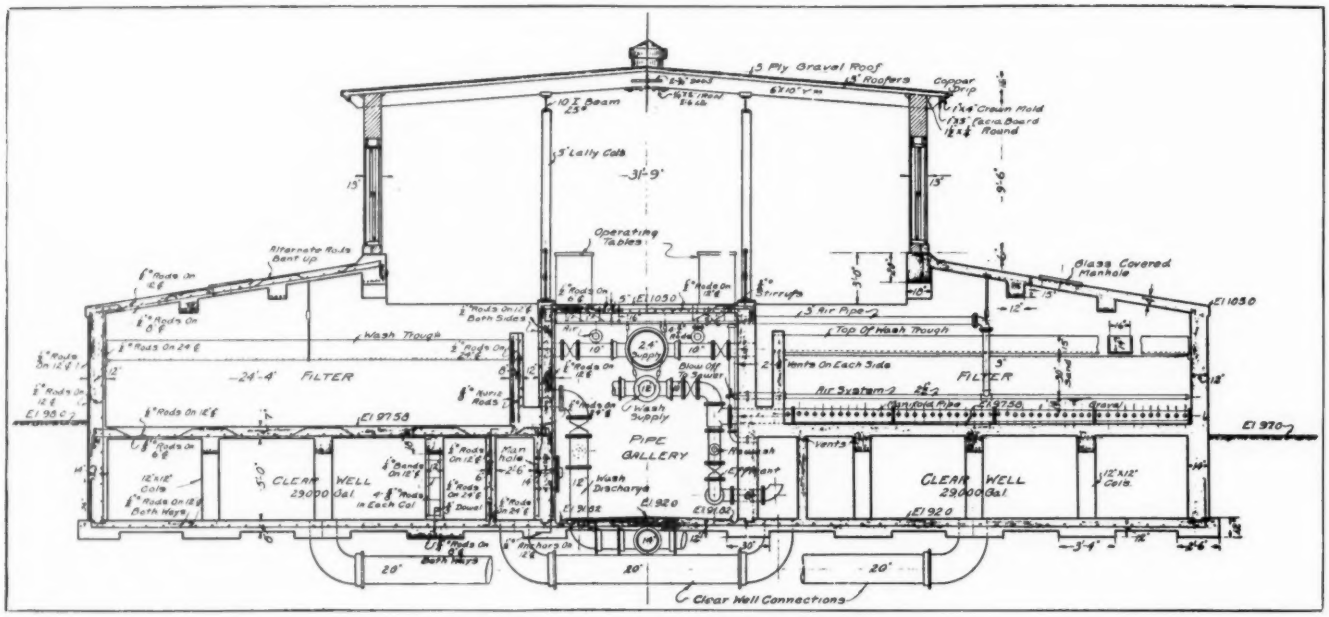
Chemical Treatment. — Previously made tests on samples of water from Broad Brook showed that alum used as a coagulant and soda ash to increase the alkalinity, if necessary at certain times of the year, together with a coagulating period of about two hours and the aeration treatment, would give the desired results.



Section Through Chemical Room Showing Tanks for Alum and Soda

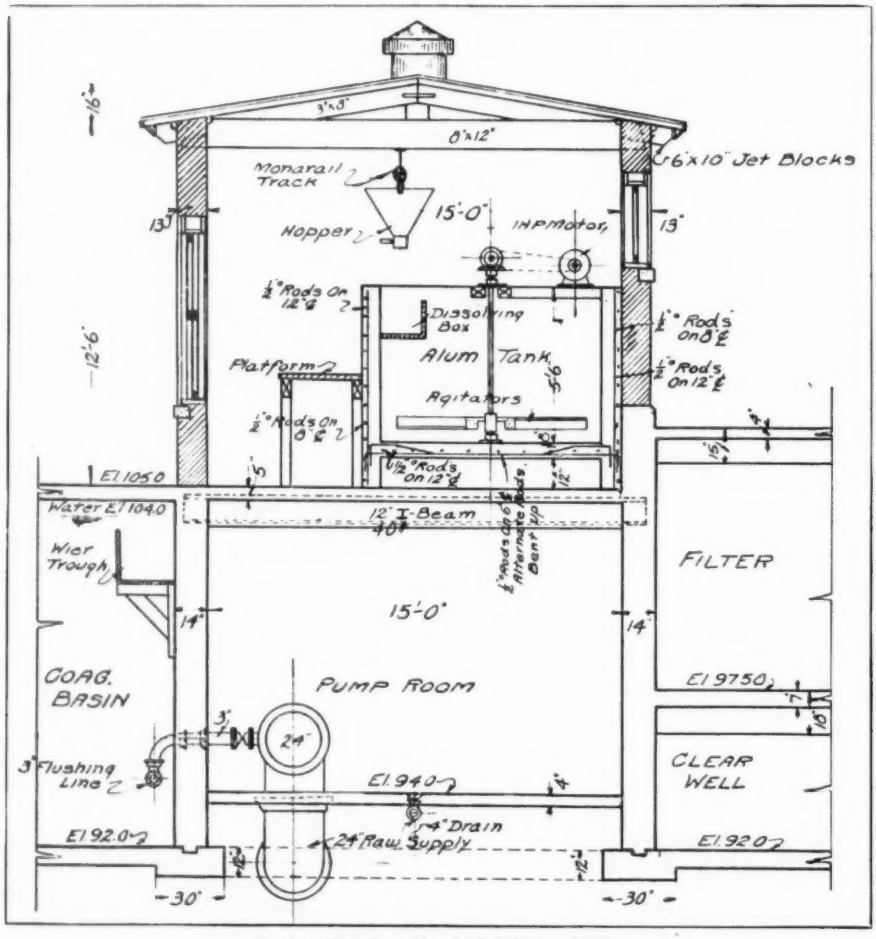
In the chemical room is provided four chemical solution tanks capable of giving a 12 hour run without re-charging. These tanks are equipped with mechanical agitation for keeping the solution at an even strength. The necessary dissolving boxes and spray pipes for dissolving the chemicals are included. The reason for two tanks for each chemical solution is that while one is in use, the other tank is being recharged. Chemical storage is provided in the chemical room and a conveyor and track is to be installed for carrying chemicals from the storage room to the tanks.

The chemical solutions are to be introduced into the water by automatic proportionate feeders at the throat of a Venturi tube in the line between the aerator and the mixing chambers adjoining the coagulation basins, to which the water is conveyed by a 20 in.



Section Showing Filters, Clear Wells and Pipe Gallery

line following aeration. These automatic feeders will feed chemicals at the rate for which they are set and in direct proportion to the amount of water flowing through the Venturi tube. The rate may be changed at any time by adjusting the orifice valve on the feeders. If the feeders are set to feed one grain per gal., they will maintain that feed for the amount of water entering the coagulation basins, regardless of what the variation of flow in the raw supply line may be. We believe this to be a feature found in but few filter plants today but which seems to us essential for the proper, efficient and economical treating of water in filtration plants.



Section Showing Chemical Solution Tank

Coagulation Basins.—There are two coagulation basins, each 92 ft. long by 31 ft. 9 in. wide, with a longitudinal baffle requiring the water to travel about 180 ft. during the detention period. There is also a perforated baffle at the head of each basin, designed to start the water through the basin with a uniform even flow at all points of cross sectional area, as it enters the basins through a 24 in. sluice gate. The basins have a depth of 12 ft. and the channel widths are 15 ft. 4 in. An under-drainage system is provided for cleaning out the basins, with blowoffs placed at intervals of about 30 ft. along the floor; the flat floor slabs sloping toward these blowoffs at the rate of 3 in. 15 ft. There are 12 such drainage points. Each of the coagulation basins may be used while the other is out of service during cleaning; there being a flushing line with hose connection for this purpose. The detention period with the plant operating at its rated capacity is about 2 hours and 15 minutes.

Filters.—From the coagulation basins, the water flows through the pump room to the pipe gallery, between the filters and has a 10-in. connection to each filter with a hydraulic valve. There are to be six filters with a total surface area of 0.04 acre; each filter being 12 ft. wide by 24 ft. 4 in. long. The water passing onto the filter units through steel troughs, later used as overflow troughs, filters down through a 30-in. layer of specially prepared sand and a 10-in. layer of graded gravel to the filter manifold system. The filtering sand is required to have an effective size of .30 to .40 m.m. and the uniformity coefficient is to be not

greater than 1.65. The filter manifold system consists of a flanged cast iron main collector pipe of special design, equipped on both sides with bells on 6-in. centers to receive 2-in. cast iron laterals. These lateral pipes will be tapped on the top side every 6 in. and quipped with cast bronze strainers. The area of the openings in the strainers is approximately .25 of 1 per cent of the sand area. The area of the laterals is three times the area of the openings in the strainer valves and the area of the manifold header is 1⅛ times the area of the laterals.

The filtered water passing out of the filter units into the pipe gallery, passes into the effluent pipe through a rate controller which controls the rate of flow through the filters. This rate may be changed at any time by setting the controller to the rate desired.

From the rate controller, the water flows into the clear water storage wells, consisting of two chambers beneath the filters, about 4 ft. deep, each having a capacity of 29,000 gal.

Washing.—The filters are cleaned by what is commonly known as the low velocity air and water wash. The wash water is supplied by a 50 H. P. pump in the pump room and the water is taken from the filtered water storage wells. Air is supplied at a 4 lb. pressure by a rotary air blower driven from the wash pump motor shaft by a link belt. The air system of piping, designed to furnish 2 cu. ft. of free air for each square foot of filtering area, is located on top of the gravel layer. It consists of brass header pipes and ⅜ in. slotted brass air tubes on 4-in. centers. The air and water are used together; the amount of water being 8 gal. for each square foot of filtering area per minute, giving a rise of about 13 in. per minute.

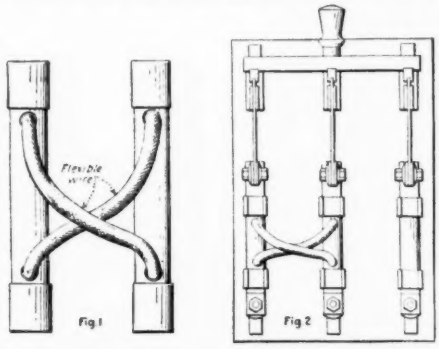
Each filter has two wash water troughs placed 15 in. above the surface of the sand. Each trough has an area of 1.55 sq. ft. and the velocity of wash water through the troughs, while washing at 8 gal. per minute per square foot, will be about 1.7 ft. per second with the trough full. The lateral draw will be 22 in. A re-wash connection is provided for draining the filter and filtering to waste after the washing process.

Controls.—All valves for operating the filters are to be hydraulically operated through 4-way cocks, located in slate operating tables at the head of each filter. On the operating tables will be placed a nickeled lever for operating each valve and an indicator for showing the position of the gate. A loss of head gauge is also provided for showing the loss of head through the filter and indicating when the filter should be washed.

The construction of the Broad Brook filtration plant and the necessary grading in connection with it is being done by the L. Suzio Construction Co. of Meriden, while the piping and installation of the filter equipment is being done by the Norwood Engineering Co. of Florence, Mass.

An Emergency Method for Reversing Polyphase Motors

David Williams, writing in Power, offers a handy kink for controlling an electric motor. A common method of reversing a motor, he reports, is through the medium of a two-pole double-throw switch. Such a means serves the purpose very nicely where there is frequent reversing of the motor. Not long ago I ran across what seemed to be a handy kink for emergency reversing. A group of motors were driving machines, and once in a while the product would jam in such a way that the machines would have to be reversed to get operation started again.



Figs. 1 and 2—Cross-Connected Fuse Cases and How They Were Used in the Motor Switch

The motors were 220-volt three-phase and protected by fuses. At first, whenever it was necessary to reverse one of the machines, the electrician interchanged two of the motor leads at the switch. This took considerable time and to say the least was not a desirable way of doing the job, and it always required the electrician to do the work. Instead of putting a reverse switch in on each of the motors, the ends of two empty fuse cases were cross-connected with flexible wire as indicated in Fig. 1. These were left with the machine operators, and whenever the occasion arose for reversing a machine, the operator opened the motor switch, removed two of the fuses and inserted the cross-connected fuse cases as shown in Fig. 2.

This device, however, is not a reverse switch and cannot be considered as such, but is a handy method that can be used where it is necessary to reverse a three- or a two-phase motor at infrequent intervals. During the reverse period the motor is protected by only one fuse, but this is not a serious objection, as operation under this condition is only for a few minutes at any one time.

New Red Protective Paint for Motors

Industrial uses of electric motors in the Pittsburgh district are adopting the new red protective paint developed by the General Electric Co. for use with direct-current electric motors which are subject to acids, alkalies, oil or dust.

This paint is used effectively on the ends of the commutators and between the ends of the commutator bars and comb, to prevent the entrance of oil, moisture, carbon and copper dust. In the Pittsburgh territory there are some companies which, upon installing a new commutator, apply a coat of this new paint to the section where the V rings fit in. The new comb rings are then installed and the insulated parts of the commutator are painted with the paint.

A number of mining companies in the central Pennsylvania field are using the paint on storage battery locomotives when a new battery is installed. The battery box, container and top of the cells and terminals are given a liberal coat. This prevents corrosion.

The field coils on direct-current pumps, motors exposed to oil and moisture, and the stators of induction motors are also being painted by several users. One coal mining company in Windber has also used the material for protecting the motors of mine locomotives, and in another instance the paint has been used to protect the under side of automobile mudguards. Several electrical repair shops in the district are informing their customers that the new paint must be used to protect the insulation adjacent to the commutator bars of direct-current motors. Among those using the product are manufacturers of fuel oil burner.

No. 880 Red Protective Paint, handled by the merchandise department of the General Electric Co. at Bridgeport, Conn., is said to prevent gas, oil and water leaks. It can be applied by brushing or dipping, requiring no priming, and produces a hard, smooth and glossy film.

Meeting of Rocky Mountain Water Works Men.—The next meeting of the Rocky Mountain Section of the American Water Works Association will be held Feb. 23rd and 24th, 1928 at Denver, Colo. and Feb. 25th, 1928 at Pueblo, Colo. Dana E. Kepner, State Board of Health, 420 State Office Building, Denver, Colo., is secretary.

Water Works Men Meet in March.—The next meeting of the Montana Section of the American Water Works Association will be held at Lewiston, Mont., March 8th, 9th and 10th, 1928. H. B. Foote, Director Division of Water and Sewage, State Board of Health, Helena, Mont., is secretary.

Huge Power Works in Switzerland

Fig. 1.—The Region Along the Grimsel, Above Meiringen, Bernese Oberland, Switzerland, Where the Grimsel Power Works Are Being Constructed, Showing Structures and Future Water Levels

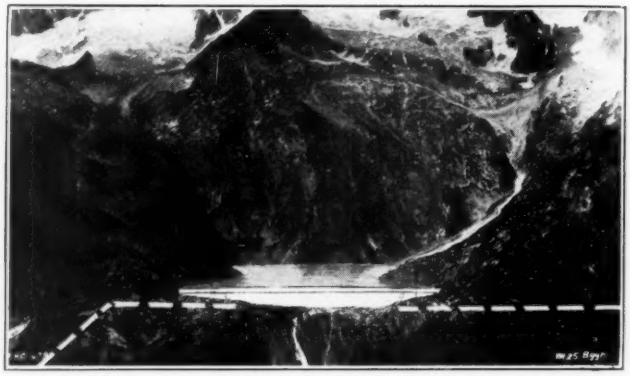


Fig. 2.—The Reservoir Lake "Gelmer" Above Meiringen, in the Bernese Oberland, Switzerland, Forms Part of the Grimsel Power Works. Dotted Lines to Left Show Conduit to Power Station

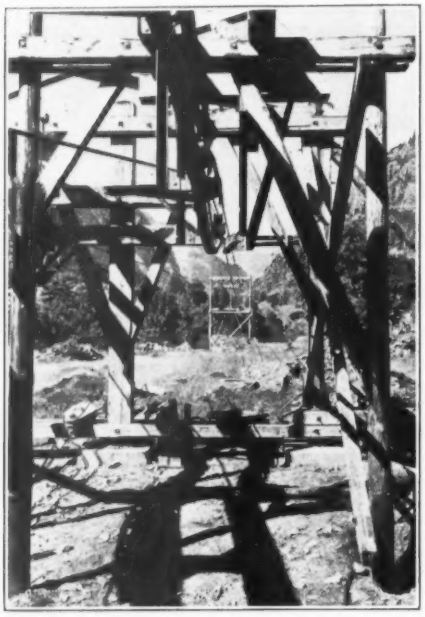


Fig. 3.—Aerial Line From Meiringen Affords Transportation to the Work

Great things are going on in the watershed of the Grimsel in Switzerland, leading from Meiringen to Gletsch (Rhone Glacier). Here for a number of years engineers and workmen have been engaged in the construction of the Oberhasli Power Works, more generally known as the Grimsel Works.

For this project the river Aare, discharged by the Unter and Oberaar Glaciers, is utilized to Innertkirchen, near Meiringen in three stages. The total fall amounts to some 4,175 ft. Two reservoir lakes at Gelmer and on the Grimsel will have an effective capacity of 399,000,000 cu. ft. The drainage area of the lakes comprises 42.8 sq. miles.

The Aare is dammed at the Grimsel by two concrete walls, one 328 ft. and the other 98.4 ft. high. The surface of the Grimsel Lake amounts roughly to 1 sq. mile, the effective capacity to 3,531,000,000 cu. ft. The Gelmer Lake is raised 98.4 ft. by damming and a lake of 0.23 sq. mile surface and 459,-100,000 cu. ft. effective capacity is formed. The connecting tunnel between the two lakes is 3.26 miles long and its diameter 6.56 ft. The conduit from Gelmer Lake to the power station is formed by an armored pressure shaft of 6.56 to 7.22 ft. diameter. The Handeck Power Station will contain 4 vertical-shaft units, each of 25,000 hp. The current is transmitted under a pressure of 50,000 volts by means of cables into the valley. The transformation to 150,000 volts is effected in an outdoor substation at Innertkirchen. There are three power stations, located at Handeck, Boden and Innertkirchen, respectively. The Handeck Power Station will generate a constant yearly output of 223,000,000 kwh.; after completion of the two lower stages, the aggregate constant yearly output, measured at Innertkirchen under 150,000 volts can be raised to 538,000,000 kwh. It is also possible to provide further storage ponds, and utilize further streams in the Oberhasli region. The project was put forward by the Bernese Power Works.

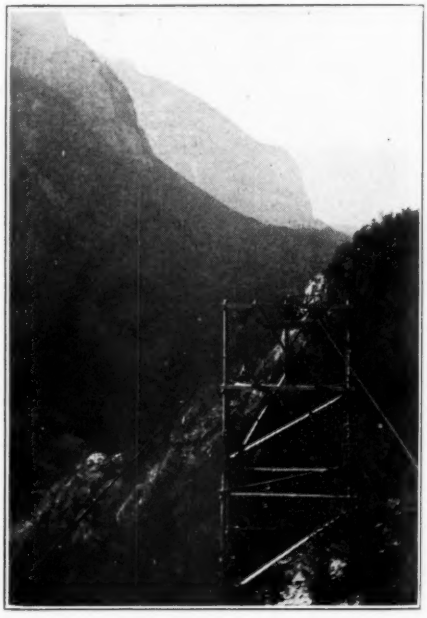


Fig. 4.—Another View of the Aerial Line From Meiringen to Grimsel

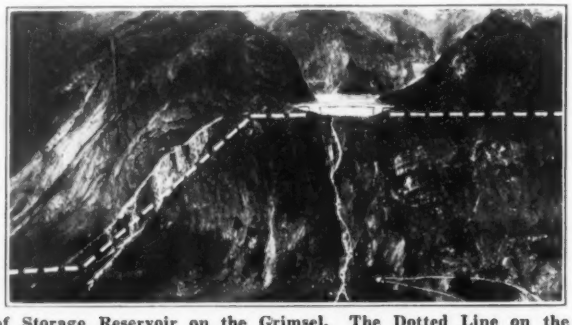


Fig. 5.—View of Storage Reservoir on the Grimsel. The Dotted Line on the Right Indicates Conduits From Grimsel Lake, While the Line to the Left Is the Power Conduit to the Handeck Power Station

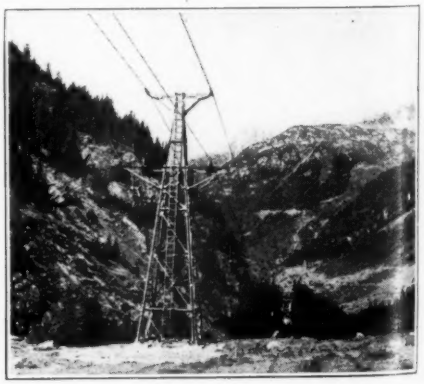


Fig. 6.—Steel Tower on Aerial Line to the Work

One Course Concrete Curb Construction

How Modern Methods Produced Remarkable Results at Detroit Told in Concrete Highways

One of the most interesting developments following the widespread adoption of one-course concrete curb and combined curb and gutter has been the remarkable records established for amounts of curbing built in one working day. Many excellent plans have been perfected with the result that time and labor costs have been reduced and wasteful practices have been abandoned in favor of modern methods which place curb work on a plane with advanced street paving construction.

A View of the Concrete Crew. The Placing and Finishing Operations Are Kept Close Behind the Mixer

One of the first contractors to organize one-course concrete curb construction in such a manner as to eliminate heavy wheelbarrow labor and to increase the amount of curbing built in one day by one crew with one mixing machine was the Mark R. Hanna Co., R. W. Burks, superintendent in charge of construction, of Detroit, Mich. That the method developed is also applicable to combined curb and gutter work is evidenced by the fact that the R. D. Baker Co., using methods very similar, built as much as 2,800 lineal ft. of combined curb and gutter in a nearby city in one working day this season.

Some Production Records.—In 1924 the Hanna Co. used the ordinary 1-bag mixer, with wheelbarrows to charge the skip and to transport the concrete from the mixer to the forms. The average daily production was about 500 lin. ft. This average was raised to about 700 ft. per day in 1925, with 1,200 lin. ft. as a maximum day's run. A typical crew consisted of from 26 to 28 men. In 1926 they experimented with and perfected the organization and method which has enabled one crew of 37 men to place over 201,000 ft. of straight one-course curb from the beginning of the construction season in 1927 to Sept. 1, with a probable total of 275,000 lin. ft. for the season.

The average run is 2,500 lin. ft. per 10-hour day. The maximum day's run this year is 4,063 lin. ft.

How the Work Is Handled.—The following methods were used in order to obtain the above production. A full caterpillar tread 21-E paving mixer was used. An old type paving mixer spout, with a gate near the end was used for delivery of the mixed concrete into the forms. One man holds a wooden splash board in front of the spout in such a way as to direct the concrete into the forms and prevent loss or misplacement.

All curb is placed after the rough grade is completed and prior to fine grading. The mixer is run along the grade about 4 ft. from the curb, the spout swinging out over the curb. Aggregates are mechanically loaded from nearby stock piles into two trucks which haul direct to the mixer and dump into the skip in the usual manner. The mixer operator empties the drum into the spout in small quantities. The man tending the spout operates the small shut-off gate in the spout, and with the splash board operator controls the delivery of concrete into the forms. Two men spade the concrete in the forms, then two float men, one bull nose man, two finishers and one brush man follow in succession. The finished curb is 20 in. deep, 6 in. wide and divided by templates into uniform blocks 6 ft. long. Particular care is taken to see that after the steel separating templates are removed, a clear opening is maintained between the upper 7 in. of the units. A ⅜ in. expansion joint is placed every 24 ft. A bull nose of 1 and 1¼ in. radius is troweled on the top edge facing the street. A one minute mix is specified and maintained. A 1:2:3 mix with 1-in. maximum size aggregate is used. This makes an excellent curb with practically no spalling.

The Man Closest to Mixer Handles Spout Gate, the Next Forward Roughly Spreads and Spades Concretes in Forms, the Third Gives Curb Top a Finished Floating and the Last Man Completes Finishing and Rounds Top, Inside Edge

Another advantageous feature of this type of curb is that should the street require widening the section can easily be moved back and reset, practically without loss. In 1923 the

Geo. R. Cooke Co. paved Dexter Boulevard, Detroit. Due to the subsequent rapid growth in population in this section of the city it became necessary to widen the street in 1926. When the widening was done, the old concrete curb was moved back to the new curb line without the loss of a single unit.

Curb work in Detroit is done under the supervision of the Department of Public Works, John W. Reid, Commissioner, P. A. Fellows, City Engineer.

Sand-Shoeing Motor Traffic

How Chicken Wire Solved Problem of Road Maintenance over Soft Ground

By H. A. FINCH
Major, U. S. Army, Fort Humphreys, Va.

When the Pershing Expedition crossed the border at Columbus, New Mexico, in March, 1916, to chase the bandit Villa, the troops found a dirt road running south to Colonia Dublan, Parral and other Mexican towns on the Villa line of retreat.

This road had been packed and worn smooth and hard by generations of light Mexican wagons. Even the 'dobe stretches were hard and apparently ready to stand up under the punishment inflicted by army truck trains.

Within two weeks the road began to go to pieces, beginning of course with the stretches of sand and 'dobe. Within two months the situation had become serious. On the 75-mile section from Columbus to Colonia Dublan fully 40 miles had disintegrated so badly that the truck trains on which the fate of the expedition at that time depended could not be kept on schedule and could be kept in service only with the greatest difficulty.

On the 'dobe stretches pot holes developed ranging up to 12 and 15 in. in depth. These were concealed by the fine, impalpable dust which filled them. Down would go one or both of the front wheels; up would fly the powdered 'dobe in swirls that made breathing a job and that got in behind even fur-rimmed goggles. Pot hole succeeded pot hole; the long lines of trucks, one by one, blundered into them and laboriously climbed out in low gear, while over all hung a thick pall of dust that turned trucks, cargoes and passengers as gray as Norwegian rats.

On the sand stretches the situation was hardly better. Trucks could get through in second gear provided the trucks ahead kept moving and provided the foot-deep ruts were not filled by the road workers or by trucks that did not track. The worst feature on these stretches was the tendency of the trucks to create humps and hollows in the ruts. A rock or an extra hard bit of sand material would start the business. The wheel would be thrust upward by the obstruction; this brought about a down thrust on the opposite wheel which tended to form a hollow. As wheel No. 1 dropped off the obstruction the down thrust was shifted to that side and a hollow started to match a hump on the other side. Every pair of wheels of innumerable trucks repeated the process and aggravated the condition until there would be a full mile of sand waves to rack the motor vehicles and to distress the desert voyager. The effect on the passengers was even more potent than riding a bucking boat in a cross swell; more than one hard-boiled soldier learned that one does not have to go to sea in order to be "seasick." The chauffeurs had a hard time of it; many did not stand the gaff and most of those who did had to be treated for kidney trouble at one time or another during their service with the expedition.

The army engineers with the expedition have never told the full story of their trials and sufferings. All sorts of schemes were discussed; all sorts of arguments raged. The sand waves could be leveled off but they reappeared in a day or two as soon as the ruts were formed again. On the 'dobe stretches a little relief could be secured at times by detouring over the plains —the Mexican plains dotted with prairie dog hills and covered with sage brush. This relief was totally inadequate.

For a time hopes were had that the approaching rainy season would provide the water to act as a binder for the 'dobe while the sun baked it hard —just as today in the Imperial Irrigation District south of the Salton Sea the custom is to irrigate half of the high-crowned 'dobe roads while the freshly baked other side is in service.

The plan was fine and the hopes were high—but the rains never came, and all the work of laboriously crowning miles of road was lost.

To shorten a long story, no satisfactory solution of the problem was devised during the 11 months the Americans were in Mexico. Of course had it been known in advance that the expedition was to stay in Mexico for that length of time it would have been advisable perhaps to resort to light railways, but the uncertainty of the army's tenure combined with a dearth of equipment ruled this expedient out. Plank roads and concrete pavements were even more out of the question due to the nature of the job in hand and the large amount of material required for this sort of construction.

The only expedient that gave any satisfactory relief was the plan, suggested early and finally adopted, of scraping a roadway out of the ground instead of mounding it on the ground level or about it.

On some stretches it was practicable, after much brushing, to have the heavy-duty road graders scrape off the heavy loose material on top and uncover harder material below. This operation had to be repeated periodically and at best it provided a road surface of hard patches alternating with soft spots—and the hard material soon disintegrated.

Fortunately for the American forces, the Carranzistas wanted Villa caught. They therefore authorized the use of the railroad from El Paso to Chihuahua. But for this it is certain that either the railroad would have been taken over by the Americans forcibly or the troops would have been withdrawn earlier. The expedition could not live on supplies brought in by trucks.

As stated, the army engineers, in spite of prayers and perspiration, found no satisfactory solution of their road maintenance problem. But had they only known it, the solution was fairly simple. Chicken wire would have done the business. This was proven in wholesale and conclusive fashion by Allenby's engineers when the problem confronted them of maintaining roads for the British forces in their drive across 240 miles of semi-desert country between Suez and Jerusalem.

Chicken wire had been largely used on the Allied front in France for revetting trench side walls, and the British supply department had sent quantities of it to Suez on the assumption that it would be used there. However trenches were not resorted to on the Palestine front and the chicken wire, thousands of rolls of it, stayed in storage until some unidentified British engineer conceived the idea of utilizing it for "sand-shoeing" a truck highway across the miles of sandy stretches.

Few details of this successful large-scale experiment have been published in this country, so far as known, but it appears that the wire was of the ordinary 1½-in. mesh and that three strips were used superimposed for each wheel track. The 3-ply "sand-shoe" was pegged down by long wire staples. Some sand sifted upward through the meshes, of course, but in the 3-ply arrangement this was just enough to protect the wire strands from undue wear and not enough to make heavy going for the trucks.

Whether or not the engineer would have hit on the solution of his problem if the chicken wire had not been under his eye is not the question. The outstanding fact is that this expedient simplified a most difficult problem. It is doubtful if any other one thing contributed so much toward the success of Allenby's campaign in Palestine.

Wisconsin County to Vote on $2,553,000 Bond Issue.—Sheboygan County, Wisconsin will vote April 3 on an $2,553,000 bond issue for road improvements.

Pavement Widths

Recommended for Streets in Chicago Region by Chicago Regional Planning Association

Thirty years ago the average street vehicle required a lane only 7 or 8 ft. wide in which to move with ease and safety. Since then, however, highway travel has been revolutionized; vehicles have increased in numbers, move faster and are made wider, yet many municipalities have failed to change their width standards when building new pavements. One reason for this can be attributed to the force or precedence that past practice exerts upon new work. Another is the lack of a new standard for property owners and village or city officials to follow when preparing paving petitions and ordinances.

To provide such a set of width standards is the following summary and recommendations have been prepared by the committee on highways of the Chicago Regional Planning Association. The standards represent the combined opinion of many engineers and officials of the region and members of the committe on highways of the Chicago Regional Planning Association and also conform to standards now in use throughout the United States.

Recommendations

Lane Widths. — The recommended lane widths or unit dimensions which, when combined, form total widths, are as follows:

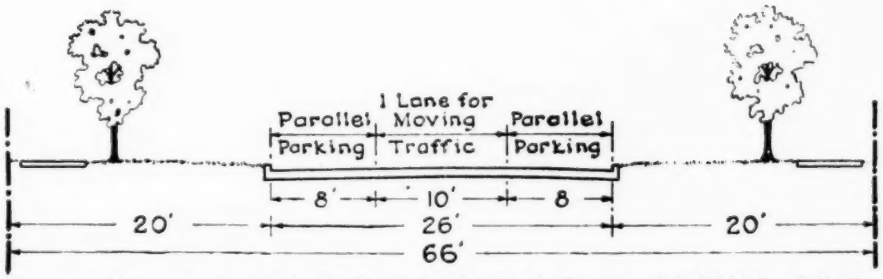
A. Lane for moving traffic.....10 ft.
B. Lane for parking parallel to curb ..... 8 ft.
C. Lane for parking at angle with curb .....18 ft.

The lane widths above are believed to be minimum for safety and free movement of traffic under all conditions; light, darkness, rain, snow, ice and dry weather. They are also considered maximum because a slightly wider lane invites the crowding in of another vehicle which is dangerous.

Diagonal Parking.—Parking at an angle on main thoroughfares is not generally recommended except where the pavement is wider than is necessary for moving traffic. The dimension given is capable of being converted into two lanes, a 10 ft. lane for moving traffic, and an 8 ft. lane for parallel parking.

Clearance. — State laws generally limit the width of vehicles to 96 in. or 8 ft., and there are many trucks and busses which approach this dimension. While the average passenger car is only about 6 ft. wide, it requires greater clearance for safety and free movement under all weather conditions than the wider, slower moving truck.

Odd Number of Lanes.—Unless properly regulated an odd number of lanes for moving traffic on major streets is believed to be unsafe because the di-

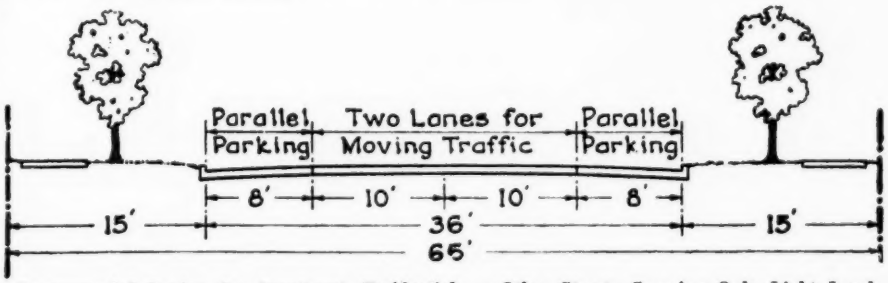


Recommended Section for Single Family Residential Streets Carrying Only Light Local Traffic and Having Parallel Parking

26 foot pavement provides:
1. 1 lane for moving traffic, 10 feet wide.
2. 2 lanes for parked cars, each 8 feet wide.

This width is recommended as minimum for single family residential streets carrying very light local traffic only. Although 26 feet allows only one lane for moving traffic, ordinarily two cars can pass by one turning into an unoccupied section of a parking lane.

Fire departments often object to pavements this narrow but if corners are well rounded, curb radii not less than 20 feet, they should experience no difficulty in moving their apparatus, provided there is not too much parking.

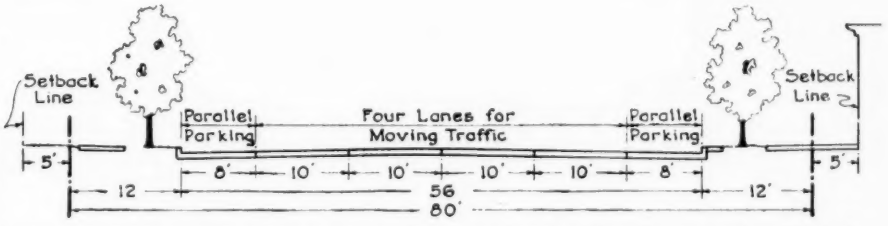


Recommended Section for Apartment, Residential, or Other Streets Carrying Only Light Local Traffic and Having Parallel Parking

36 ft. pavement provides:
1. 2 lanes for moving traffic, each 10 ft. wide.
2. 2 lanes for parked cars, each 8 ft. wide.

This width is recommended as minimum for apartment and residential streets carrying light and local traffic only.

For a local business street a 36 ft. pavement may cause congestion with resulting inconvenience and danger to shoppers. When business begins to locate on a 66 ft. street a building setback line should provide for at least an 80 ft. width so that a wider pavement may be built when traffic demands.



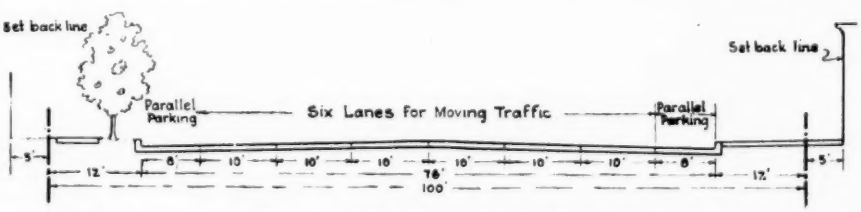
Recommended Section for Business or Other Streets Carrying Very Dense Traffic and Having Parallel Parking

76 ft. pavement provides:
1. 6 lanes for moving traffic, each 10 ft. wide.
2. 2 lanes for parked cars, each 8 ft. wide.

Where traffic is very dense this width is recommended for:
1. Business streets.
2. Streets connecting business centers.
3. Streets connecting with heavily traveled state or county highways.
4. Double street car line streets. (Outside width of two street cars is about 20 ft.)

In business districts sidewalks can be made wider than 12 ft. by requiring the 5 ft. setbacks recommended in the Association's subdivision Ordinance.

Streets which need a 76 ft. pavement and are not now 100 ft. wide should be widened.



Recommended Section for Business or Other Street Carrying Dense Traffic and Having Parallel Parking

56 ft. pavement provides:
1. 4 lanes for moving traffic, each 10 ft. wide.
2. 2 lanes for parked cars, each 8 ft. wide.

This width is recommended as minimum for:
1. Business streets.
2. Streets connecting business centers.
3. Double street car line streets. (Outside width of two street cars about 20 ft.)

In business districts sidewalks can be made wider than 12 ft. by requiring the 5 ft. setbacks recommended in the Association's Subdivision Ordinance.

Streets which need a 56 ft. pavement and are not now 80 ft. wide should be widened.

rection of travel in the center lane is too often in dispute and is therefore the cause of accidents.

Street Cars.—Where street cars occupy space in the vehicle roadway, lane widths should be figured from the outside edge of the street cars.

Total Pavement Widths.—The total roadway widths recommended are 26, 36, 56 and 76 ft. and are shown in detail in the illustration. The width of pavement to build on any particular street can be determined from the discussion and notes which accompany each cross section.

Personnel of Committee.—The Committee on Highways of the Chicago Regional Planning Association consists of the following:

Chairman, Marshall E. Keig, Vice-Pres., Consumers Company; J. R. Blackhall, Vice-Pres., Chicago and Joliet Electric Ry.; Andrew Christensen, Engr., Chicago, Milwaukee and North Shore Ry.; George W. Craig, Dist. Engr., Asphalt Association; William G. Edens, Illinois Highway Improvement Association; F. E. Ertsman, Illinois State Automobile Association; E. L. Gates, DuPage County Superintendent of Highways; N. M. Griffin, Vice-Pres., Mack International Truck Corp.; Claude Hanson, Kane County Superintendent of Highways; John B. Hittell, Chief Engr. of Streets, Chicago Board of Local Improvements; G. N. Lamb, List. Eng., Illinois Division of Highways; Olaf Langeley, North Twp. Good Roads Committee, Lake County, Indiana; R. R. Leffler, Eng., Sanitary District of Chicago; R. M. Lobdell, Lake County (Ill.) Superintendent of Highways; E. J. McIlraith, Eng., Chicago Surface Lines; George A. Quinlan, Cook County Superintendent of Highways; Frank T. Sheets, Chief Highway Engr., Illinois Division of Highways; Will H. Smith, Will County Superintendent of Highways; Peter S. Theurer, Motor Truck Division, Ill. State Auto. Assn.; Wm. J. Titus, Chief Engr., Indiana State Highway Commission; James T. Voshell, Dist. Eng., U. S. Bureau of Public Roads; C. K. Wallace, Lake County (Ind.) Surveyor; C. Weymouth, Deputy State Hwy. Engr., Wisconsin Highway Commission; Hugh E. Young, Chief Engr., Chicago Plan Commission.

$3,000,000 for Repairing Flood Damage in New Hampshire.—At a special session of the New Hampshire legislature last month, a bond issue of $3,000,000 was authorized to repair damage to roads and bridges caused by the floods of December. To provide funds to meet payment of the bonds a 1 ct. additional tax on gasoline was levied. The total gas tax in the state is now 4 ct.

Legal Angles on Construction Tangles

Hints to Contractors Given in Communication of Intermountain Branch A. G. C.

By A. H. RICH
Attorney, Salt Lake City, Utah

For some time I have been intending to give emphasis in the interest of members of the Contractors' Association with reference to the importance of keeping records on the progress of work.

Better to Adjust and Compromise.—Members of the association should not carry a chip on their shoulder nor should they always be looking for a fight, and my years of experience in the legal business have taught me that it is always better to adjust and compromise differences rather than to go to court, wherever you can do so with self-respect and get anything like a square deal on the compromise or adjustment. I am sure also that this is the sentiment and feeling of the association members as evidenced by their great desire to have an arbitration clause inserted in contracts wherever possible.

This desire to live at peace with our neighbors and to have our work satisfactory to all concerned should not, however, lull us into such a state of security as to make us the victims of our own foolishness, and it is of the utmost importance that members of the association should be advised to keep adequate and complete records of everything that occurs in the course of any operation. This is particularly necessary now in view of the splendid thing which was enacted by the last legislature in giving us a right to sue or arbitrate with the State Road Commission.

The Importance of Adequate Records.—There is nothing so important, when discussing adjustments, arbitrations, or in presenting your case before a court of law as those things which are reduced to writing. The memory of man is such an uncertain thing and so many things occur which must be decided by the word of one or two persons against the word of another, and so often recollections are warped by self-interest or a desire to escape embarrassment, particularly on the part of the engineer, architects and owners that too often meritorious causes are lost through a total lack of evidence.

Written documents, papers, figures and communications of all kinds are of the utmost importance and should be kept for a reasonable length of time after all jobs are completed.

In addition, there is nothing so valuable as a diary or daily record kept by the persons in charge of a job. It takes only a few minutes at the end of each day to jot down the important operations, conversations and things occurring during the day, particularly on matters involving directions, instruction and decisions relating to the operation.

Use of Photographs.—It is also a splendid thing to always have a kodak on hand for use of your superintendent. I recently tried a lawsuit involving damage by sheep to a highway under construction. It was almost impossible for the jury to visualize how the sheep had tramped down the corners, disturbed the fines and coarses in the material and destroyed the forms. A kodak picture of this after the sheep had gone over the highway would have meant a lot of money to the contractor. This is also important in the matter of bringing home to a jury the character of barricades and warnings which are placed for the protection of the public. Juries are described by Elbert Hubbard as being the ignorance of one man multiplied by twelve, and it is sometimes very difficult for them to visulize exact conditions. Nothing helps so much as a photograph.

When Accidents Occur.—In the event of any accident or injury occurring, it is of the utmost importance to obtain the names, addresses and statements of persons present and seeing the same, and on such occasions it is of the utmost importance that interested persons have as little as possible to say in the presence of third persons or people who might posibly be on the other side of a lawsuit. Too often admissions are made which, in the light of subsequent developments, prove incorrect and are embarrassing. When a structure falls, contractors have too often assumed responsibility for it, whereas subsequently it may develop to be a fault of the engineer or architect, and under such circumstances interested persons should reserve their comments until a complete investigation has been made.

I submit these comments, not with the idea of inducing contractors to be more litigious, but simply in the hope that they may adopt good business like methods, which may mean thousands of dollars to them.

Road Construction in Wayne County, Michigan.—During the fiscal year ending Aug. 31, 1927, the Board of County Road Commissioners of Wayne County, Michigan, in conjunction with the state highway department on trunk line, federal aid and inter-county covert roads and on county roads and assessment district roads completed 1,112,047 sq. yd. of concrete of an average thickness of 9 in., bringing the total yardage up to 7,025,258. The total yardage in new roads is 731,769, adding 47.058 miles of concrete road to the existing system, to this must be added 380,278 sq. yd. which was poured in widening out 28.907 miles of old concrete roads to the ultimate minimum width of 40 or more feet.